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DTU Space
National Space Institute
Technical University of Denmark

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December 2015

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EUROPEAN SPACE AGENCY CONTRACT REPORT

ESA Contract No. 4000110600/14/NL/FF/lf

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Authors:
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Front page: The airborne team in Danmarkshavn, credits Christina Dybbøl Nielsen

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ESA STUDY CONTRACT REPORT

ESA CONTRACT NO 4000110600/14/NL/FF/lf	**SUBJECT** Technical Support for airborne ASIRAS and laser scanner measurements during 2014 CryoVEx campaign in the Arctic		**CONTRACTOR** National Space Institute (DTU Space)
ESA CR No	**STAR CODE**	**No of volumes** 1 **This is Volume No** 1	**CONTRACTORS REFERENCE** CryoVEx 2014

ABSTRACT

This report outlines the airborne field operations with the ESA airborne Ku-band interferometric radar (ASIRAS), coincident airborne laser scanner (ALS) and vertical photography to acquire data over sea- and land ice along validation sites and CryoSat-2 ground tracks. The airborne campaign was coordinated by DTU Space using the Norlandair Twin Otter (TF-POF). The campaign consisted of two experiment periods: Mid-march to early April and late April to mid-May with focus on sea ice and land ice, respectively.

The sea ice measurements covered several validation sites with sea ice camps located in the Beaufort Sea lead by US office of Naval Research (ONR) and north of Greenland as a dedicated ESA CryoVEx initiative. In addition, selected CryoSat-2 ground tracks were under-flown in the Lincoln Sea from CFS Alert, North of Greenland and Svalbard from St. Nord and Longyearbyen. Several of the flights in the Beaufort and Lincoln Sea were coordinated with Uni. of York (UY) lead Basler aircraft towing an electromagnetic (AEM/EM bird) sounder to obtain sea ice thickness and Operation IceBridge (OIB) NASA P-3 carrying a variety of instruments for sea ice and snow retrievals.

Land ice measurements were acquired over the Greenland ice sheet (the EGIG line and selected CryoSat-2 ground tracks), together with Austfonna and Devon ice caps. At Austfonna and Devon ice caps ground teams measured ice and snow properties, and raised corner reflectors acting as a surface reference point in order to estimate the penetration depth of the ASIRAS radar. An opportunity site on the Greenland Ice Sheet was surveyed near Jakobshavn Isbræ. No other ground experiments were coordinated with the CryoVEx campaing on the Greenland Ice Sheet.

The CryoVEx 2014 campaign was a success and the processed data is of high quality. The data set includes 13 CryoSat underflights covering distances from 25-560 km. The preliminary comparisons to CryoSat-2 data show the potential of the extensive dataset.

Names of authors:

S. M. Hvidegaard, J. E. Nielsen, S. L. Sandberg Sørensen, S. B. Simonsen, H. Skourup, R. Forsberg, V. Helm, and T. Bjerg

NAME OF ESA STUDY MANAGER Tânia Casal Mission Science Division Validation Campaigns - ESTEC	**ESA BUDGET HEADING**

Contents

1 Introduction

In continuation of the CryoSat-2 Validation Experiment (CryoVEx) carried out in 2011 and 2012, the European Space Agency (ESA) initiated a third Arctic post-launch campaign in 2014 to further calibrate and validate CryoSat-2 data products. The purpose of CryoVEx 2014 was to acquire data along transects of CryoSat-2 ground tracks and over ground experiment sites through a coordinated major effort involving a large group of European, Canadian and US scientists.

This report outlines the airborne field operations with the ESA airborne Ku-band interferometric radar (ASIRAS), coincident airborne laser scanner (ALS) and vertical photography to acquire data over sea- and land ice along validation sites and CryoSat-2 ground tracks. The airborne campaign was coordinated by DTU Space using the Norlandair Air Twin Otter (TF-POF), which is the same aircraft as used in former CryoVEx campaigns.

The campaign consisted of two experiment periods: Mid-march to early April and late April to mid-May with focus on sea ice and land ice, respectively.

The sea ice measurements covered several validation sites with sea ice camps located in the Beaufort Sea lead by US office of Naval Research (ONR) and north of Greenland as a dedicated ESA CryoVEx initiative. In addition, selected CryoSat-2 ground tracks were under-flown in the Lincoln Sea from CFS Alert, North of Greenland and Svalbard from St. Nord and Longyearbyen. Several of the flights in the Beaufort and Lincoln Sea were coordinated with Uni. of York (UY) lead Basler aircraft towing an electromagnetic (AEM/EM bird) sounder to obtain sea ice thickness and Operation IceBridge (OIB) NASA P-3 carrying a variety of instruments for sea ice and snow retrievals.

Land ice measurements were acquired over the Greenland ice sheet (the EGIG line and selected CryoSat-2 ground tracks), together with Austfonna and Devon ice caps. At Austfonna and Devon ice caps ground teams measured ice and snow properties, and raised corner reflectors acting as a surface reference point in order to estimate the penetration depth of the ASIRAS radar. An opportunity site on the Greenland Ice Sheet was surveyed near Jakobshavn Isbræ. No other ground experiments were coordinated with the CryoVEx campaing on the Greenland Ice Sheet.

An overview of the ground tracks of the airborne campaign are presented in Figure 1a supplemented by Figure 1b with the westernmost tracks. For a more detailed description, the CryoVEx 2014 campaign objectives are outlined in the ESA Arctic Campaigns 2014, Campaign Implementation Plan (editor: T. Pearson).

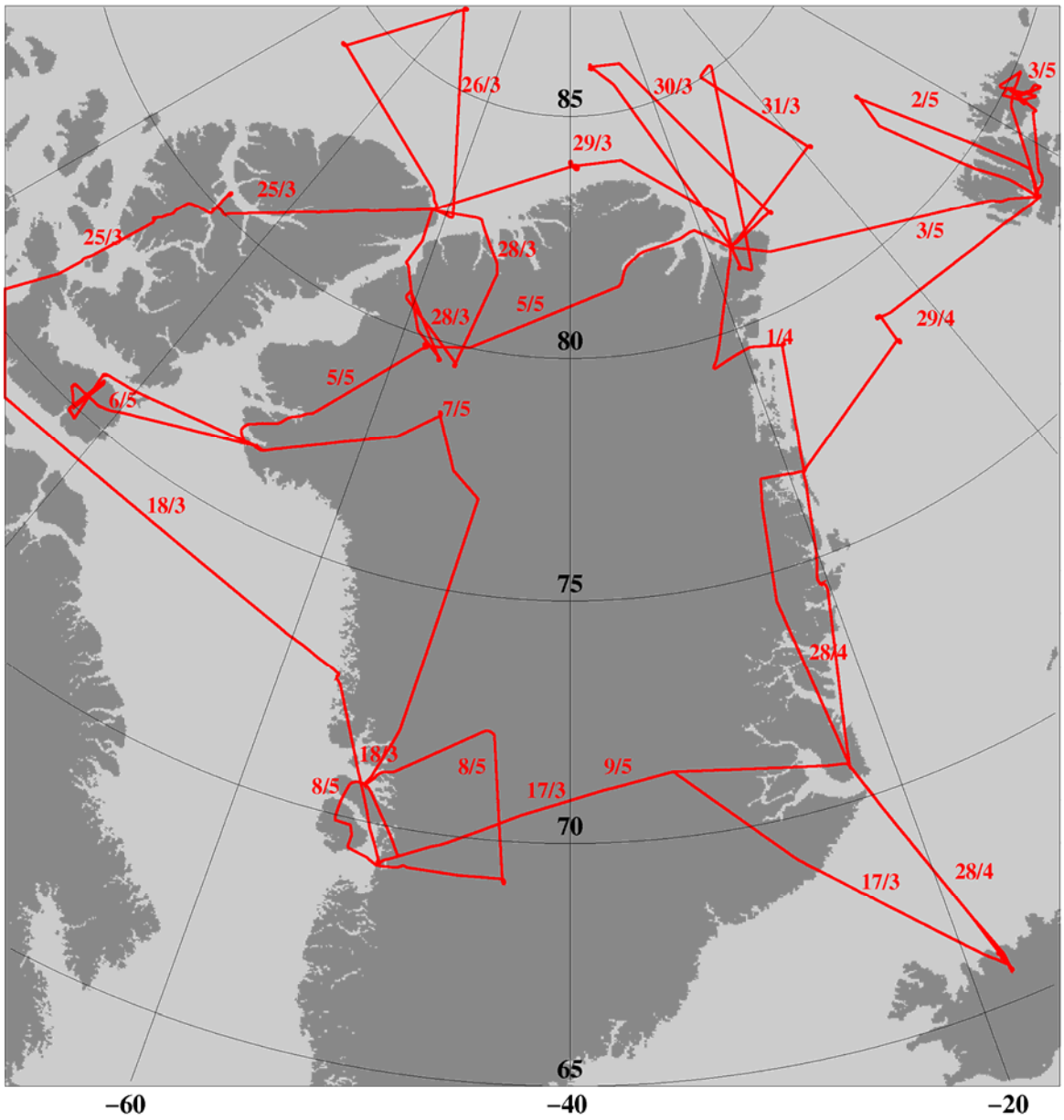


Figure 1a: Overview of the flight tracks (red lines) from the CryoVEx 2014 airborne campaign. Dates of the respective flights are marked next to the flight lines.

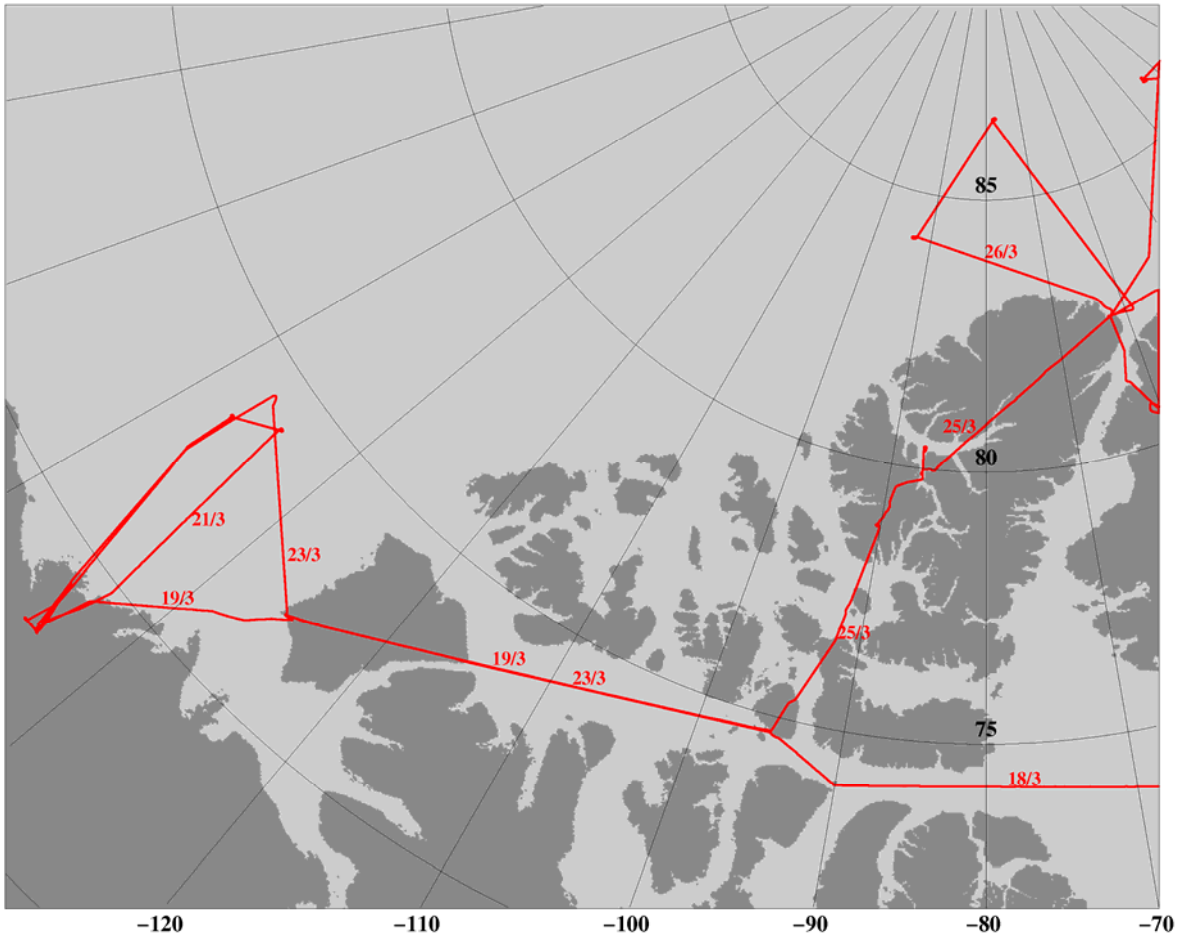


Figure 1b: Flight tracks (red lines) from the CryoVEx 2014 airborne campaign in the Canadian Arctic. Dates of the respective flights are marked next to the flight lines.

2 Summary of operation

The CryoVEx 2014 airborne campaign was conducted as two separate operational periods. The sea ice activities covering large parts of the western Arctic Ocean were planned to take place early in the season to make sure the weather was stable and to ensure cold conditions of the sea ice itself (target temperatures of -20^{o}C and below). Therefore, logistics and permissions were organized for the period March 17 to April 1 including flight permission in Canada, Greenland, and Norway, access to military facilities CFS Alert, Canada, and St. Nord, Greenland, support by Polar Continental Shelf Project (PCSP), and various accommodations. The second part of the campaign was carried out on April 28 – May 9, mainly to cover the Greenland Ice Sheet, Austfonna and Devon ice caps, but also the sea ice north of Svalbard and in the Fram Strait.

A Norlandair Twin Otter (reg: TF-POF) was chartered for the entire campaign, which is the same aircraft as used throughout previous CryoVEx campaigns. The instrument certification for the aircraft was obtained in 2006 (Hvidegaard and Stenseng, 2006). The flight altitude is typically 300 m limited by the range of the laser scanner with a nominal ground speed of 135 knots. The speed can be decreased to about 110 knots, which is necessary in connection with formation flights with Basler aircraft when flying the EM-bird; however the relatively low speed results in an increase of the pitch by a few degrees. The aircraft is equipped with an extra ferry tank permitting longer flights (5-6 hrs), and an autopilot for better navigation accuracy. In good conditions the across-track accuracy is down to a few meters using a custom-made navigation system connected to geodetic GPS receivers.

The installation of the ASIRAS radar and laser scanner (ALS) took place in Akureyri, Iceland. The main installation and test of ASIRAS were performed by experienced staff from Radar System Technique (RST).

First part of the campaign started with long transit flights from Iceland via Greenland to Inuvik, Canada. From Inuvik CryoSat-2 under-flights of sea ice in the Arctic Ocean were coordinated with Uni. of York chartered Basler aircraft towing an electromagnetic sounder (AEM) and NASA's IceBridge P-3 carrying multiple sensors for sea ice and snow retrievals. These flights also covered ONR sea ice camps AW1 and AW2. Additional sea ice surveys were carried out from CFS Alert and St. Nord including CryoVEx camp over-flights. A more detailed overview is given in Section 6.1.

Second part of the campaign primarily covered the land ice. The first main validation site surveyed was the Austfonna ice cap. On transit flights to/from Svalbard surveys were done over the margin of the Greenland Ice Sheet and over sea ice in the Fram Strait including one upward looking sonar (ULS) buoy run by the Norwegian Polar Institute. The Austfonna flight was done on May 3 after waiting for proper weather for several days. Afterwards, the Twin-Otter (T-O) continued directly to St. Nord, Greenland, to be positioned for the Devon flight after the Thule AB weekend closure. On May 6 the Devon flight was done followed by Greenland Ice Sheet flights with a re-survey of the EGIG line on the transit back to Iceland by the end of the campaign. Flights on the ice caps (Devon and Austfonna) were coordinated with scientists taking measurements on the ground along CryoSat-2 ground tracks and transects of special glaciological interest, see Section 6.2 for more information.

In general, the weather was favorable and most of the transit flights were used to collect additional data. This includes:

- Measurements in the Eureka Sound coordinated with Environment Canada ground experiments and NASA P-3 flight
- Survey of the area near the Peterman Glacier, NE-Greenland coordinated with Fugro GeoSAR measurements
- Survey of the 79N glacier and a few other areas of the E-Greenland Ice Sheet margin.
- Flights in the Fram Strait to repeat flight tracks from 2006, 2008, and 2011, together with overflight of an upward looking sonar (ULS) buoys owned by NPI.
- Over-fligth of the NEEM camp site and the glacier of Disko Island
- Measurements of the ground experiment site near Jakobshavn glacier by the group from Uni. of Edinburgh

Calibration flights of the instruments over buildings and runways were performed whenever possible. Corner reflectors were erected at the sea ice camps and along flight tracks on Austfonna and Devon ice caps to be used as reference point to estimate penetration depth and potential time shifts of the ASIRAS radar. For a more detailed description see Section 5.3 and 5.4.

The DTU Space part of the CryoVEx 2014 campaign ended on May 9 back in Akureyri where it started after 123 airborne hours. The flight tracks are shown in Figure 1a and b and a list of the flights are found in Table 1. A day-to-day overview is given in Section 2.1 and operator logs and plots of flight tracks are provided in Appendix 1.

A total of 13 CryoSat-2 ground tracks were flown, covering various distances. Whenever possible the tracks were timed to match the CryoSat-2 passage times, however this was hampered by limited airport opening hours, e.g. CFS Alert. A more detailed description of the operations of the validation sites is given in Chapter 6.

The CryoVEx 2014 campaign was a success and the CryoSat-2 science community now has a collection of unique measurements to analyze as an extension to the data time series from the previous campaigns.

The airborne team consisted of Sine M. Hvidegaard (SMH), Rene Forsberg (RF), Emil Nielsen (EN), Louise Sandberg Sørensen (LS), Sebastian B. Simonsen (SBS) assisted by Wolfram Borisch (WB) from Radar System Technique (RST) during the ASIRAS installation. ESA manager Mark Drinkwater (MD) participated in the second part of the first sea ice campaign from Resolute Bay to Akureyri.

Table 1: Overview of CryoVEx 2014 flights. Flights along CryoSat-2 tracks and CryoVEx validation sites are highlighted by blue.

Date/DOY	Flight	Track	Take off UTC	Landing UTC	Airborne	Airborne accumulated	Survey operator
1703/76	A	Test-flight	12:11	12:46	35 m		SMH/EN
1703/76	B	AEY-EGIG-JAV	14:40	20:15	5 h 35 m	6 h 10 m	SMH/EN
1803/77	A	JAV-JUV	12:33	14:14	1 h 41 m	7 h 51 m	SMH/EN
1803/77	B	JUV-POS-YRB	15:04	20:38	5 h 34 m	13 h 23 m	SMH/EN
1903/78	A	YRB-YSY	16:35	20:20	3 h 45 m	17 h 08 m	SMH/EN
1903/78	B	YSY-YEV	21:32	23:35	2 h 03 m	19 h 11 m	SMH/EN
2003/79		YEV-YEV (cancelled)	17:26	18:47	1 h 21 m	20 h 33 m	SMH/EN, RF
2103/80		YEV-CS20942-AW-YEW	14:33	20:33	6 h 00 m	26 h 33 m	SMH/EN, RF
2303/82	A	YEV-AW-YSY	14:27	18:56	4 h 29 m	31 h 02 m	SMH/EN, RF
2303/82	B	YSY-YRB	20:29	00:26	3 h 57 m	34 h 59 m	SMH/EN, RF
2503/84	A	YRB-YEU	13:21	16:50	3 h 29 m	38 h 28 m	SMH/RF, MD
2503/84	B	YEU-YLT	18:07	20:35	2 h 28 m	40 h 56 m	No survey
2603/85		YLT-CS-CS-YLT	14:35	19:42	5 h 07 m	46 h 03 m	SMH/RF, MD
2803/87		YLT-CS-Petermann-CS-YLT	14:55	19:55	5 h 0 m	51 h 03 m	SMH/RF, MD
2903/88		YLT-camp-E-NRD	13:44	18:06	4 h 22 m	55 h 25 m	SMH/RF, MD
3003/89		NRD-CS-camp2-F-NRD	12:20	17:41	5 h 21 m	60 h 46 m	SMH/EN, MD
3103/90		NRD-CS-NRD	16:22	21:23	5 h 01 m	65 h 47 m	SMH/RF, MD
0104/91	A	NRD-79fj-TOB-CNP	09:51	15:17	5 h 26 m	71 h 13 m	SMH/EN, MD
0104/91	B	CNP-AEY	15:56	18:10	2 h 14 m	73 h 27 m	No survey
2804/118	A	Test-flight	11:48	12:17	29 m		SMH/LSS, EN/SBS
	B	AEY-CNP	13:17	15:41	2 h 24 m	2 h 53 m	
	C	CNP-B-DMH	16:00	19:15	3 h 15 m	6 h 08 m	
2904/119		DMH-ULS-LYR	09:49	13:44	3 h 55 m	10 h 03 m	
0205/122		LYR-seaice-LYR	10:03	13:59	3 h 56 m	13 h 59 m	SMH/LSS, SBS
0305/123	A	LYR-Austfonna-LYR	08:23	13:31	5 h 08 m	19 h 07 m	SMH/LSS, SBS
0305/123	B	LYR-NRD	14:44	17:46	3 h 02 m	22 h 09 m	LSS, SBS
0505/125		NRD-THU	09:51	15:08	5 h 17 m	27 h 26 m	LSS, SBS
0605/126		THU-Devon-THU	12:27	17:18	4 h 51 m	32 h 17 m	LSS, SBS
0705/127		TAB-ICE4-ICE3-NEEM-CS21627-JQA	14:20	19:47	5h 27 m	37 h 44 m	LSS, SBS
0805/128		JQA-Disko-CS21706-JQA	12:26	17:14	4 h 48 m	42 h 32 m	LSS, SBS
0905/129	A	JQA-EGIG-CNP	11:08	15:54	4 h 46 m	47 h 18 m	LSS, SBS
0905/129	B	CNP-AEY	16:25	18:44	2 h 19 m	49 h 37 m	LSS, SBS
Total						**123 h 04 m**	

2.1 Day to day

The airborne part of CryoVEx 2014 progressed as follows:

March 14	Scientists Copenhagen to Akureyri, Iceland
March 15-17	Installation and test flight, Akureyri, Iceland, survey of building and runway
March 17-19	Transit flights to Inuvik, Canada via Ilulissat, Upernavik (Greenland), and Resolute Bay, Sachs Harbour (Canada)
March 20	Coordinated flight with Basler AEM cancelled due to low clouds
March 21	Flight along CryoSat-2 track 20942, 15 min delay at line start, near coincident with Basler AEM flight, survey of ONR camp sites AW1 and AW2
March 22	No flight
March 23	Survey of ONR sites AW1-AW3, partly cloudy, followed by transit to Resolute with refuelling in Sachs Harbour
March 24	No flight
March 25	Transit to Alert via Eureka with survey of Env. Canada fast ice site in Eureka Sound coincident with NASA P-3
March 26	Flight along CryoSat-2 tracks 21011 and 21021 in formation with Basler AEM survey and NASA P-3
March 27	No flight due to storm condition
March 28	Coincident TO and Basler AEM flight but EM-bird power problem. TO flight changed to survey Petermann Glacier
March 29	Transit to St. Nord with survey of CryoVEx sea ice camp (main site) north of Greenland coincident with Basler AEM
March 30	Flight along CryoSat-2 track no. 21067 and survey of CryoVEx sea ice camp extended survey site
March 31	Flight along Cryosat-2 track no. 21081 and 21090 in formation with Basler AEM and NASA P-3. Excellent coordination between TO and Basler aircraft at CS-2 track at satellite passage time (UTC 19:48)
April 1	Transit St. Nord to Akureyri via Constable Pynt. Survey of 79N Glacier en route
April 2-3	Un-mount instruments and scientist Akureyri to Copenhagen
April 26	Scientists Copenhagen to Akureyri

April 27	Installation of instruments and GPS survey of calibration building. Ground test
April 28	Test flight near Akureyri and transit to Danmarkshavn via Constable Pynt
April 29	Transit to Longyearbyen, Svalbard, with survey over sea ice in Fram Strait including ULS buoy site
April 30-May 1	No flight due to weather conditions at Austfonna (snow, clouds and windy)
May 2	Marginal conditions at Austfonna, tried to fly the glacier but clouds too low. Alternated to sea ice flight north of Spitsbergen, Cryosat-2 track no. 21544 (not coincident in time) and repeated track from 2011
May 3	Flight over Austfonna ice cap, good conditions except clouds over northern part. Transit to St. Nord with survey of sea ice in Fram Strait. Planned survey over Kongsvegen cancelled due to clouds. Overflight of runway and calibration building at St. Nord
May 4	No flight
May 5	Transit to Thule AB with survey of Academy glacier and north Greenland ice sheet
May 6	Flight over Devon Ice Cap. CryoSat-2 tracks and repetition of linesflown at previous CryoVEx campaigns. Belcher glacier skipped due to clouds.
May 7	Second Devon flight cancelled due to high winds and clouds in the area. Survey of CryoSat-2 track no. 21656 along western part of Greenland ice sheet. On transit to Qaarsut repeated flight from CryoVEx 2008
May 8	Flight of CryoSat-2 track 21706, Jakobshavn Isbræ opportunity site, and Disko Island
May 9	Transit to Akureyri via Constable Pynt with survey of the EGIG line enroute. Survey of calibration building in Akureyri
May 10	Un-mount instrument
May 11	Scientist Akureyri to Copenhagen

3 Hardware installation

The installation of the ASIRAS system was identical to the setup used throughout the CryoVEx 2011/12 campaigns (Skourup et al, 2013a and 2013b), using the certification for the Twin Otter (TF-POF) acquired in 2006 (Stenseng et al, 2007). To support the ASIRAS system a Novatel GPS DL-V3 was kindly loaned from the Alfred Wegener Institute (AWI).

The ALS equipment was of type Riegl LMS Q-240i (also used in CryoVEx 2012, 2011, and 2008). To prevent malfunction of the ALS during the extreme low temperatures (-20^{o}C and below) in the first part of the campaign, the ALS was wrapped with external heater pads. In addition, an external heater fan as well as an electrical heater, were installed in the instrument bay in the rear baggage compartment of the aircraft, see Figure 6. An older version of the ALS Riegl (LMS Q-140i) was carried along as backup unit.

In addition, three geodetic dual-frequency GPS receivers were mounted for precise aircraft positioning. The receivers (AIR1, AIR2 and AIR3) were connected to two separate GPS antennas ("front" and "rear") through antenna beam splitters. The GPS antennas are permanently installed on TF-POF. Receiver types, antenna information, as well as logging rates for the GPS receivers are given below:

- AIR1 Receiver type Javad Delta front antenna logging rate 5 Hz
- AIR2 Receiver type Javad Delta rear antenna logging rate 1 Hz
- AIR3 Receiver type Javad Delta front antenna logging rate 1 Hz

The higher logging rate for AIR1 was chosen to obtain a higher precision for the on-board navigation system. Offsets between GPS antennas and ASIRAS/ALS are given in Table 2.

To record the attitude (pitch, roll and heading) of the aircraft, two inertial navigation systems (INS) were used. The primary unit is a medium grade INS of type Honeywell H-764G. This unit collects data both in a free-inertial and a GPS-aided mode at 50 Hz. Specified accuracy levels in roll and pitch are better than 0.1^{o}, and usual accuracy is higher than this. A backup INS is provided by an OXTS Inertial+2 integrated GPS-INS unit, with a nominal similar accuracy as the H-764G. The Honeywell INS was connected to the front GPS antenna and the OxTS used a dual antenna setup with the rear GPS antenna as primary antenna.

To collect visual imagery of the surfaces surveyed, two cameras were mounted next to the ALS in the rear baggage compartment of the aircraft, see Figure 7. The cameras were a GoPro photo/video camera in time laps mode (to limit the data volume) and a uEye webcam as backup system. On most of the flights both cameras were operated collecting nadir looking images.

The setup of the instruments in the aircraft is shown in Figure 2 and pictures of the various instruments are shown in Figure 3-7.

Table 2: The dx, dy and dz offsets for the lever arm form the GPS antennas to the origin of the laser scanner, and to the back centre of the ASIRAS antenna (see arrow Figure 2).

To laser scanner	**dx (m)**	**dy (m)**	**Dz (m)**
from AIR1/AIR3 (front)	- 3.70	+ 0.52	+ 1.58
from AIR2/AIR4 (rear)	+ 0.00	- 0.35	+ 1.42
to ASIRAS antenna	**dx (m)**	**dy (m)**	**dz (m)**
from AIR1/AIR3 (front)	-3.37	+0.47	+2.005
from AIR2/AIR4 (rear)	+0.33	-0.40	+1.845

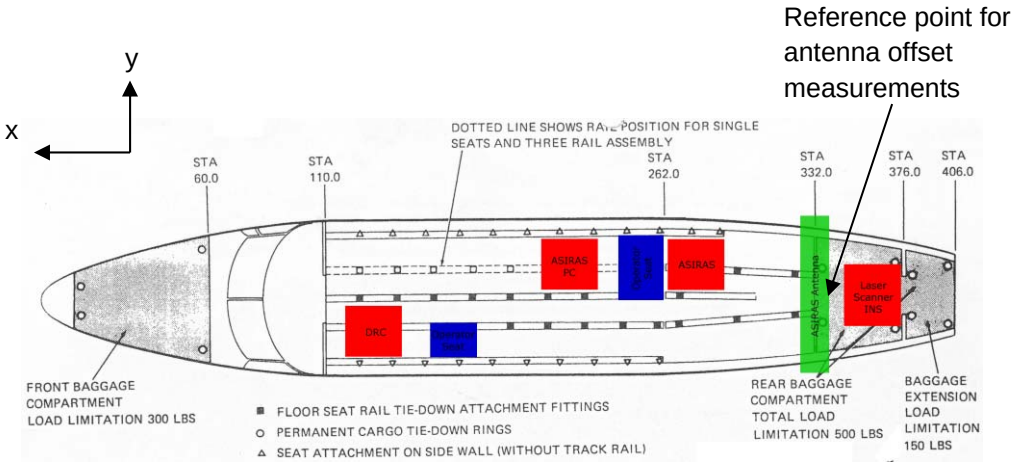


Figure 2: Overview of instrument setup in the TF-POF Twin Otter aircraft.

Figure 3: ASIRAS antenna.

Figure 4: View of cabin in aircraft; Rack with ASIRAS PC's (front right), rack for ALS, GPS and INS (rear left). Spare fuel tank for extra airborne time (front left).

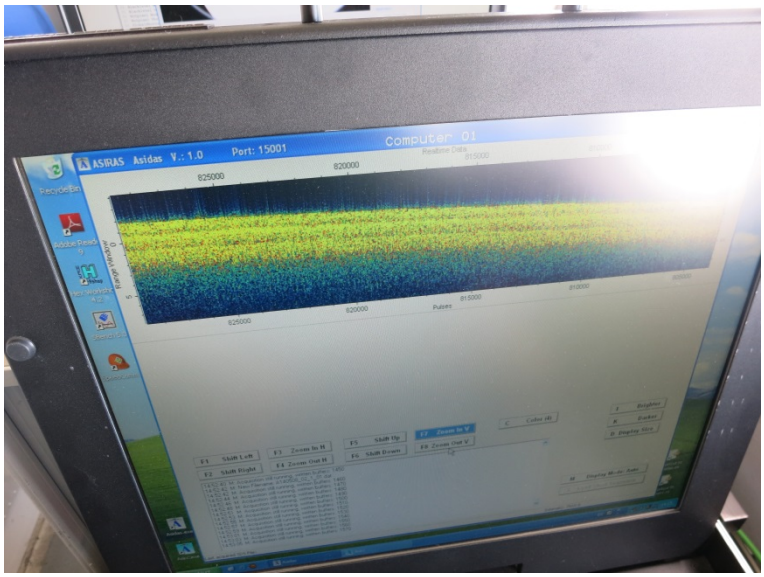


Figure 5: Snapshot of ASIRAS operation display over land ice.

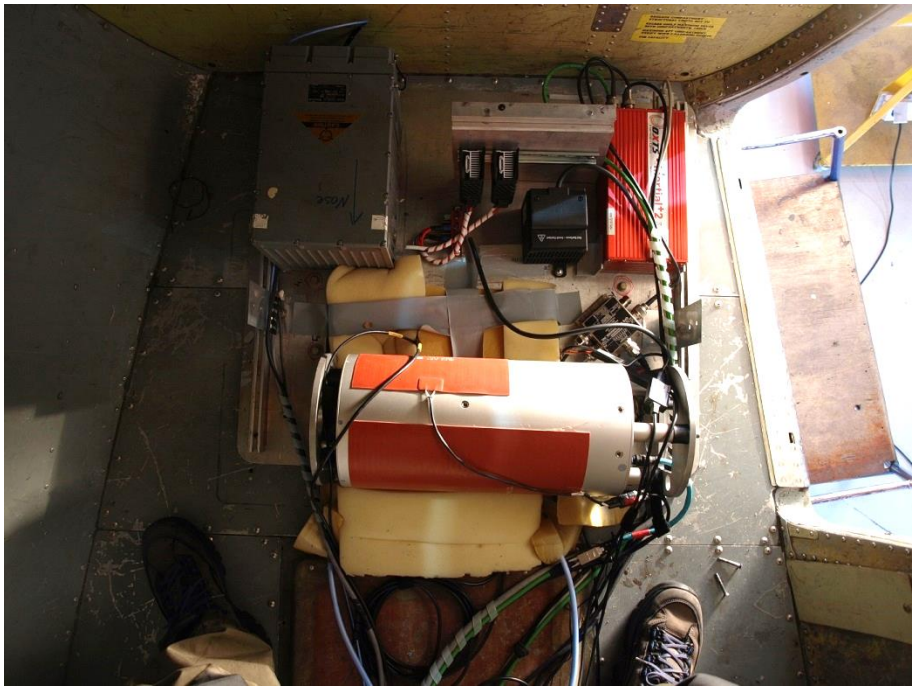


Figure 6: Instrument bay in rear baggage compartment of the aircraft. In front laser scanner RIEGL LMS Q-240i with heater pads (grey/orange instrument). H-764G INS (grey box) and OXTS INS (red box) in the back. Between the two INS instruments are mounted two external heaters (small black boxes).

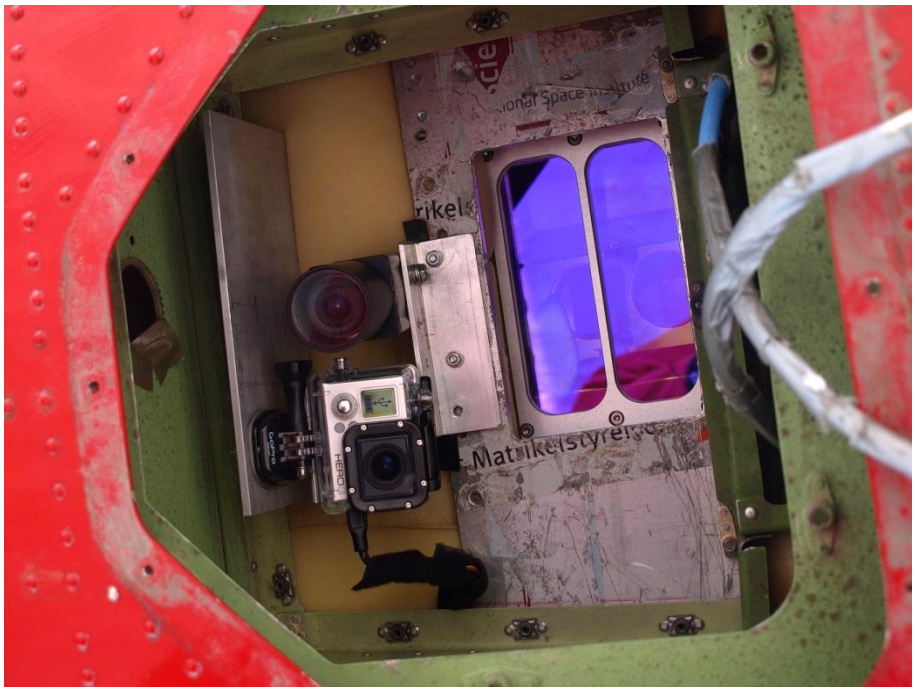


Figure 7: Photo taken from below through hole in aircraft; visible instruments are laser scanner (purple windows) and nadir looking cameras (left).

4 Overview of acquired data

Data from the various instruments were acquired where feasible, considering the limited height range of the ALS system and the weather. An overview of all acquired data is listed in Table 3.

All the ASIRAS data were acquired in Low Altitude Mode (LAM) with low along-track resolution (LAMa). This allows flight at an altitude of 300 m, which is within the operational range of the ALS system and a relative low data volume of about 28 GB per hour. A total 2.76 TB raw ASIRAS data were collected during the CryoVEx 2014 campaign. The data were stored on hard discs as ASIRAS level 0 raw data in the modified compressed format (Cullen, 2010) and has been shipped to the Alfred Wegener Institute (AWI) for further processing.

The ASIRAS system performed well during the campaign and the PC only crashed on two occasions:

- 26-03-2014 PC1 freezes and is rebooted
- 31-03-2014 Software freezes and is rebooted

This only caused loss of few minutes of data before the system was up and running.

In general, the ALS worked well. At extreme low temperatures (below -20^{o}C), experienced through the first part of the campaign, moisture on the inside of the instrument prevented the laser to see through the instrument window. Total blocking of the laser signal was only an issue during take-off most likely due to the extreme temperature decrease caused by the acceleration of the aircraft, which caused the moisture to freeze. To circumvent the laser to lock on the frozen instrument window, the ALS was switched to measure the “last laser pulse”. It took about 30-45 minutes after take-off to heat the system to obtain full scan width. Data were only lost on the first EGIG flight from Akureyri to Ilulissat on March 17 (DOY 76). On almost all measurement sites surveying began more than 30 min after take-off and therefore no significant data loss occurred – on transit flights part of the scan width is missing for the first 30-45 min of the flights.

The data volume obtained by the ALS is about 250-300 MB an hour which is a relative small amount, when compared to the ASIRAS data volume. During the campaign a total of 29.8 GB ALS data were acquired.

The airborne GPS units logged data internally in the receivers (AIR1, AIR2 and AIR3) during flight, which were downloaded upon landing on laptop PCs. The Novatel GPS was dedicated to support ASIRAS and was not part of the logging system. GPS files were recovered for all receivers at all flights, except on two occasions, March 19 (DOY 78) where the AIR1/3 were restarted and March 31 (DOY 90) where AIR1 had a full memory card and a small part of the end of the flight is missing – since the other GPS receivers worked on these flights both ASIRAS and ALS data can be processed. The GPS reference stations listed in Table 3 are described in further detail in Section 5.1.

Both INS systems logged continuously throughout the campaign and no problems were observed with the systems. Due to the restart of GPS’es the OxTS INS was also restarted on March 19 (DOY 78) and on one occasion the logging PC for the Honeywell INS crashed causing loss of data on this transit

flight – backup data from OxTS will be used for this flight. An operator error caused mis-alignment of the Honeywell INS resulting in missing data on one transit flight on May 8.

Vertical photography was collected during flights primarily to support the analysis of ALS data over sea ice. Pictures were acquired every 2 seconds for most flights by nadir-looking photography.

All data are stored on external hard discs, as well as servers located at DTU Space servers with backup system.

Figure 8: Photo of Norlandair Twin Otter (TF-POF) at Sachs Harbour, Canada – refueling from drums. Photo: S. M. Hvidegaard.

Table 3: Overview of data.

Date	DOY	AIR1	AIR2	AIR3	EGI H-764G	INS OxTS	ALS	ASIRAS	GPS REF1	GPS REF2	GPS REF3	WEBCAM	GoPro	Log	Remarks
17-03-2014	76A	X	X	X	X	X	X	LAMa	AEY					X	test
17-03-2014	76B	X	X	X	X	X	X[1)]	LAMa						X	
18-03-2014	77A	X	X	X	X	X								X	Transit
18-03-2014	77B	X	X	X	X	X	X[2)]					X		X	
19-03-2014	78A	X[3)]	X	X[3)]		X[3)]	X		YEV			X	X	X	
19-03-2014	78B	X	X	X	X	X	X		YEV			X	X	X	
20-03-2014	79	X	X	X	X	X			YEV1	YEV2		X	X	X	Survey cancelled
21-03-2014	80	X	X	X	X	X[4)]	X	LAMa	YEV1	YEV2		X	X	X	
23-03-2014	82A	X	X	X	X	X	X							X	Many clouds
23-03-2014	82B	X	X	X	X	X	X						X	X	
25-03-2014	84A	X	X	X	X	X	X							X	Many clouds except EA-EB
25-03-2014	84B						-	-						X	Transit
26-03-2014	85	X	X	X	X	X	X	LAMa	YLT1	YLT2		X[5)]	X	X	
28-03-2014	87	X	X	X	X	X	X	LAMa	YLT1	YLT2			X	X	
29-03-2014	88	X	X	X	X	X	X	LAMa	NRD1			X		X	
30-03-2014	89	X	X	X	X	X	X	LAMa	NRD1	NRD2			X	X	
31-03-2014	90	X[6)]	X	X	X	X	X	LAMa	NRD1	NRD2				X	
01-04-2014	91A	X	X	X	X	X	X	LAMa	NRD			X	X	X	
01-04-2014	91B			X	X									X	Transit
28-04-2014	118A	X	X	X	X	X		LAMa	AEY			X		X	Test
28-04-2014	118B	X	X	X	X	X	X	LAMa				X	X	X	
28-04-2014	118C	X	X	X	X[7)]	X	X	LAMa				X	X	X	
29-04-2014	119	X	X	X	X	X	X	LAMa				X	X	X	
02-05-2014	122	X	X	X	X	X	X	LAMa	LYR			X	X	X	
03-05-2014	123A	X	X	X	X	X	X	LAMa		LYR		X	X	X	
03-05-2014	123B	X	X	X	X	X	X	LAMa				X	X	X	
05-05-2014	125	X	X	X	X	X	X	LAMa				X	X	X	
06-05-2014	126	X	X	X	X	X	X	LAMa	TAB			X		X	
07-05-2014	127	X	X	X	X	X	X	LAMa				X		X	

08-05-2014	128	X	X	X	X	X	X	LAMa	JQA			X	X	X	
09-05-2014	129A	X	X	X	X	X	X	LAMa					X	X	
09-05-2014	129B	X	X	X	X	X	X	-					X	X	

1) Logging started over sea ice near East Grl, only narrow swath (due to fog on the laser window)
2)
3) AIR1/3 lost sat signal restart of OXTS, restart log on AIR1/3
4) Started late at 15:14 at beginning of CS survey line
5) Break in logging due to PC out of mem.
6) Mem full at end of survey
7) PC down 18:35

5 Processing

The data processing is divided between DTU Space and AWI. ASIRAS data is processed by AWI using GPS and INS data supplied by DTU Space. GPS differential positioning together with combined INS-GPS integration is done by DTU Space followed by processing of laser distance measurement into elevation above a reference ellipsoid. This is supplemented by geo-reference of the images taken along the flights, see Section 5.5.

5.1 GPS data processing

The exact position of the aircraft is found from kinematic solutions of the GPS data obtained by the GPS receivers installed in the aircraft, see Chapter 3. Two methods can be used for post-processing of GPS data, kinematic differential (DIF) processing and precise point positioning (PPP). Whereas the first method uses information from base stations in the processing procedure, the PPP method is only based on precise information of satellite clock and orbit errors.

The GPS base stations used as reference stations for differential post processing of the GPS data are listed in Table 4. The stations were mounted on tripods or on roofs in the field near the landing sites. It is presumed that the antenna was mounted on DTU Space large tripods (vertical height 12 cm), unless otherwise stated. The reference points were generally not marked. Examples of GPS base station and GPS survey of the calibration building in Akureyri are shown in Figure 9.

Three different GPS receivers (REF1, REF2 and REF3) were used as base stations. Information of the receiver, antenna and logging rates are listed below:

- REF1 Receiver type Javad Delta with MarAnt antenna logging rate 1 Hz
- REF2 Receiver type Javad Maxor with internal antenna logging rate 1 Hz
- REF3 Receiver type Javad Delta with MarAnt antenna logging rate 1 Hz

The base stations listed in Table 4, are named with three letters corresponding to airport codes listed in Appendix 2, followed by a number referring to REF1, REF2 or REF3. The positions of the base stations are determined using the online GPS processing services AUSPOS (http://www.ga.gov.au/earth-monitoring/geodesy/auspos-online-gps-processing-service.html) offered by Geoscience Australia. The service calculates the position of the reference stations in the ITRF 2008 reference system using data from the closest permanent GPS stations with a position accuracy of about 2 cm. This accuracy is available even in the Arctic with long distances to the closest permanent stations. The coordinates of all the reference stations used during CryoVEx 2014 are found in Appendix 3.

Table 4: Overview of CryoVEx 2014 GPS reference stations

Name	Site	Site
AEY	Akureyri	Outside Norlandair hangar on grass strip between apron and runway
YEV1	Inuvik	On snow next to apron/park of aircraft
YEV2	Inuvik	On snow next to apron/park of aircraft
YLT1	CFS Alert	Next to apron
YLT2	CFS Alert	Next to apron
STN1	Station Nord	Apron next to fuel pump
STN2	Station Nord	Apron next to fuel pump
LYR	Longyearbyen	Airport next to apron
TAB	Thule AB	Near Air Greenland hangar
JQA	Qaarsut	On fuel pump shed roof

Figure 9: GPS base stations in Akureyri (left) and survey of building to be used for calibration of the ALS (right).

The GPS processing were performed with Waypoint GrafNav (version 8.20) by use of precise IGS orbit and clock files and correction for ionospheric and tropospheric errors. For each flight several solutions are made using different combinations of GPS reference stations and aircraft receivers. The best solution for each flight is selected according to Table 5 and used in the further processing

5.2 Inertial Navigation System

The position and attitude information (pitch, roll and heading) recovered from the raw Honeywell (H-764G) and the Oxford Inertial 2+ (OxTS) INS data at 10 Hz, are merged with the GPS solutions by draping the INS derived positions onto the GPS solutions. The draping is done by modeling the function, found in the equation below, by a low pass smoothed correction curve, which is added to the INS.

$$\varepsilon(t) = P_{GPS}(t) - P_{INS}(t)$$

This way a smooth GPS-INS solution is obtained, which can be used for geolocation of laser and camera observations.

The selected INS solutions are listed in Table 5, as seen only a few of the flights on DOY 078A, 091B and 118B are using data from the backup INS unit OxTS. These sections are primarily over long straight transit flights with limited or no data collection by ASIRAS/ALS systems. These lacks of H-764G data is due to a PC reboot or mis-alignment at start up.

No further issues with the INS data from the Honeywell instrument were encountered during the processing – except for a single flight on May 8th (DOY 128) where backup OxTS data also has been used. The attitude of the backup instrument (OxTS INS) is found to have degraded accuracy during acceleration, which includes turns and rapid changes of altitude (Skourup et al, 2012). A dual antenna setup was used for the 2014 campaign; so far the analysis shows no improvement of the accuracy compared to previus campaings with only one antenna. The OxTS data has mainly been used for long straight flight tracks, which are not influenced by the degraded accuracy of the OxTS instrument.

The best solutions of both GPS and INS data based on Table 5 are packed as binary files in the special ESA file format, see Appendix 7.2 and 7.3. An overview of the final GPS and INS files are listed in Appendix 8 and 9, respectively, with file name convention according to Appendix 6.

Table 5: List of best combination of GPS and INS data

Date	DOY	File name	Reference	Processing	INS	Rover
17-03-2014	076A	076_aey_air3.p	Aey1	DIF	H-764G	AIR3
17-03-2014	076B	076_AEY-JAV_air3.p-	None	PPP	H-764G	AIR3
18-03-2014	077A	077_JAV-JUV_air3.p	None	PPP	H-764G	AIR3
18-03-2014	077B	077_JUV-YRB_air3.p	None	PPP	H-764G	AIR3
19-03-2014	078A	078_YRB-YSY_air2.p	None	PPP	OxTS	AIR2
19-03-2014	078B	078_YSY-YEV_air3.p	None	PPP	H-764G	AIR3
20-03-2014	079	079_Yyev1_air3.p	YEV1	DIF	H-764G	AIR3
21-03-2014	080	080_yev1yev2_air3.p	YEV1/YEV2	DIF	H-764G	AIR3
23-03-2014	082A	082_YEV-YSY_air3.p	None	PPP	H-764G	AIR3
23-03-2014	082B	082_YSY-YEV_air3.p	None	PPP	H-764G	AIR3
25-03-2014	084A	084_YRB-YEU-air3.p	None	PPP	H-764G	AIR3
25-03-2014	084B	084_YEU-YLT_air3.p	None	PPP	H-764G	AIR3
26-03-2014	085	085_YLT-ylt2nrd_air3.p	YLT2/NRD	DIF	H-764G	AIR3
28-03-2014	087	087_YLTylt2nrd_air3.p	YLT2/NRD	DIF	H-764G	AIR3
29-03-2014	088	088_NRD_nrd_air3.p	NRD	DIF	H-764G	AIR3
30-03-2014	089	089_NRD_nrd_air3.p	NRD	DIF	H-764G	AIR3
31-03-2014	090	090_NRD-nrd_air3.p	NRD	DIF	H-764G	AIR3
01-04-2014	091A	091_NRD-AEY_air3.p	None	PPP	H-764G	AIR3
01-04-2014	091B	091_NRD-AEY_air3.p	None	PPP	OxTS	AIR3
28-04-2014	118A	118_AEY-AEY_aey_air3.p	AEY	DIF	H-764G	AIR3
28-04-2014	118B	118_AEY-CNP_air2.p	None	PPP	OxTS	AIR2
28-04-2014	118C	118_CNP-DMH_air3.p	None	PPP	H-764G	AIR3
29-04-2014	119	119_DMH-LYR_air3.p	None	PPP	H-764G	AIR3
02-05-2014	122	122_LYRLYR-lyrair3.p	LYR	DIF	H-764G	AIR3
03-05-2014	123A	123_Lyr-LYR_lyr_air3.p	LYR	DIF	H-764G	AIR3
03-05-2014	123B	123_LYR-NRD_air3.p	None	PPP	H-764G	AIR3
05-05-2014	125	125_NRD-THU_air3.p	None	PPP	H-764G	AIR3
06-05-2014	126	126_THU-THU_thu_air3.p	None	THU	H-764G	AIR3
07-05-2014	127	127_THU-JQA_air3.p	None	PPP	H-764G	AIR3
08-05-2014	128	128_JQA-JQA_jqa_air3.p	JQA	DIF	OxTS	AIR3
09-05-2014	129A	129_JQA-CNP_air3.p	None	PPP	H-764G	AIR3
09-05-2014	129B	129_CNP-AEY_air3	None	PPP	H-764G	AIR3

5.3 Airborne Laser Scanner (ALS)

The laser scanner operates with wavelength 904 nm. The pulse repetition frequency is 10,000 Hz and the ALS scans 40 lines per second, thus the data rate is 251 pulses per line. This corresponds to a horizontal resolution of 0.7 m x 0.7 m at a flight height of 300 m and a ground speed of 250 kph. The across-track swath width is roughly equal to the flight height, and the vertical accuracy is in the order of 10 cm depending primarily on uncertainties in the kinematic GPS-solutions. The raw logged files with start /stop times are listed in Appendix 4.

5.3.1 Calibration

Calibration of ALS misalignment angles between ALS and INS can be estimated from successive overflights from different directions of the same building, where the position of the corners are known with high precision from GPS measurements. These calibration maneuvers have been carried out several times as listed below:

- 17-03-2014 DOY 76 Akureyri
- 26-03-2014 DOY 85 CFS Alert
- 29-03-2014 DOY 88 Station Nord
- 28-04-2014 DOY 118 Akureyri
- 03-05-2014 DOY 123 Station Nord
- 09-05-2014 DOY 129 Akureyri

Figure 10: Map of Akureyri airport with building used for calibration marked by red circle.

The corners of a building close to the Norlandair hangar and the runway were surveyed by geodetic GPS to be included in the calibration of the ALS and ASIRAS. The building was measured on April 27 (DOY 117).

The ALS data has been routinely processed. The calibration angles for each flights based on the calibration flights together with inspection of cross-overs and overflights of relative flat surfaces, can be found in Appendix 4.

5.3.2 Laser scanner outlier detection and removal

No major problems were encountered with the instruments. Due to the problems with moisture on the inside of the ALS (see Chapter 4), some of the flights of the first part of the campaign have reduced scan width down to about 100m. The largest effects were obtained during the first 30-45 minutes of the survey flights until the external and internal heaters had melted the ice. The scan width limits for each flight can be found in Appendix 4.

In addition, large parts of the data are contaminated by negative errors (outliers). These occur when the instrument is set in the mode (TS1) that detects the last return pulse – used when issues with moisture in the instrument. To detect the outliers, we use a diversity of criteria. Note that we throw away rejected data without attempting to interpolate or otherwise guess missing values, since data is abundant.

Our method is based around a robust linear model. For a portion (containing L data points) of each scan-line, we estimate a best fitting polynomial model of degree N using a robust linear model (RLM) via iteratively reweighted least squares using Huber's T weighing function. The RLM estimation results in three sets of data:

- estimated polynomial coefficients. These are indeed not used at all
- estimated weights from the reweighting algorithm. These are available for each data point and are on the interval [0,1]
- residuals for each data point.

The criterion by which we accept a data point or decline it as an outlier is based on a combination of the estimated weights and the residuals. We choose a parameter $0<w_{min}<1$ and decline a measurement p_i as an outlier if the corresponding estimated weight w_i is less than w_{min}. We also define a maximum deviation D_{max} from the estimated model. For a data point p_i, we look at the residual r_i, and decline the point as outlier if $|r\_i|>D_{max}$.

Because of the different nature of sea-ice and inland-ice, we need to use different criteria for the different kinds of ice. Sea ice seldom reaches more than a few meters above sea-level, Therefore, the highest deviances in sea ice data can be expected from icebergs, at a maximum of a few tens of meters. Thus, for sea ice, we can use a D_{max} value of 20 m. Furthermore, we use a 0th degree

polynomial (constant approximation) and a relatively low w_{min} value of 0.2. This results is relatively few falsely detected outliers.

For inland ice, we cannot make as strict assumptions on the behaviour of the signal, since it can be quite dynamic due to mountains protruding the ice cap, topography underneath the ice or cracks in the ice. Therefore, we need to choose a more flexible polygonal model of degree and higher w_{min} value. For each flight over land ice the various parameters were chosen to best fit the current case, and thus varies between each flight.

5.3.3 Statistical consequences:

Due to the high data volume (few tens of gigabytes of data) the outlier-detection algorithm needs to be automatic and independent of human judgement. To prevent any outliers to get through the process undetected, a rather heavy-handed choice of filtering parameters is necessary. This of course results in a considerable amount of false outliers, i.e. real physical data points, being rejected. It is therefore worth to mentioning what statistical effect the false detected outliers have on the results.

Since the outliers are caused by the instrument itself rather than by the topography, we can assume that by removing the outliers, the remaining measured points represent the real physical surface. However, in case the outliers are close to the real physical surface, the outlier-detection algorithm tends to remove some data points from the real physical surface caused by topographic features, such as crevasses and ice bergs. These real physical data points are identified as falsely detected outliers.

As the outliers are in nature negative, we prevent the outlier detection algorithm from introducing biases into the final data set, by handling positive and negative deviances from the estimated model in the same way. By doing this, the amount of positive and negative false detected outliers is assumed to be identical in numbers, and the mean of the real physical surface remains the same. Overall the amount of outliers detected and removed by the algorithm is typically less than 1% of the original data.

The above described method is excellent to remove few outliers in a given data set, but fails for clouds, as it is based on a selection procedure for each scan-line. Thus, in the case with presence of clouds the ALS data need further manual filtering.

5.3.4 Cross-over statistics

The ALS is in general of high quality with a standard deviation of cross-over differences of less than 10 cm, see Table 6, except over sea ice, where the standard deviation is increased due to drift of the sea ice. The mean of the cross-overs are less than 3 cm. The mean is in these cases a combination of errors in the GPS solutions, together with melt and accumulation over the ice sheet. An examples of cross-over differences for Austfonna ice cap are given in Figure 11.

The processed ALS elevations can be seen in Figure 12, where missing sections are mainly due to low clouds and fog.

Processed data comes as geo-located point clouds, in lines of width 200-300 m at full resolution 1mx1m, in format time, latitude, longitude, heights given with respect to WGS-84 reference ellipsoid. The data is packed in binary data files in the special ESA format, see Appendix 7.4. An overview of the processed data is given in Appendix 10 with file name convention as listed in Appendix 6.

Table 6: ALS cross-over statistics

Date	DOY	Validation site	Mean (m)	Std. Dev (m)	Min (m)	Max (m)
17-03-2014	076A	RWY Sachs H.	0.02	0.13	-3.54	1.35
25-03-2014	084	Fast ice, YEU	-0.03	0.12	-0.55	0.66
26-04-2014	085	Sea ice, drift	-0.01	0.07	-1.40	0.83
26-04-2014	085	YLT, bldg.	-0.02	0.20	-5.68	6.09
29-03-2014	088	NRD, bldg.	0.00	0.08	-1.58	2.70
31-03-2014	090	Flade Isblink, crevasses	-0.02	0.25	-15.00	8.47
29-04-2014	119	Sea ice	0.08	0.47	-3.53	3.76
03-05-2014	123A	Austfonna	-0.01	0.04	-0.19	1.51
03-05-2014	123A	Austfonna	0.03	0.04	-0.14	0.23
05-05-2014	125	GRL IS	-0.05	0.05	-0.30	0.26
06-05-2014	126	Devon	0.01	0.05	-0.23	0.25
06-05-2014	126	Devon	0.00	0.05	-0.34	0.20
07-05-2014	127	GRL IS	-0.01	0.05	-0.19	0.22
08-05-2014	128	GRL IS	0.06	0.05	-0.20	0.27
09-05-2014 17-03-2014	129A/076B	EGIG	0.00	0.09	-0.41	0.40

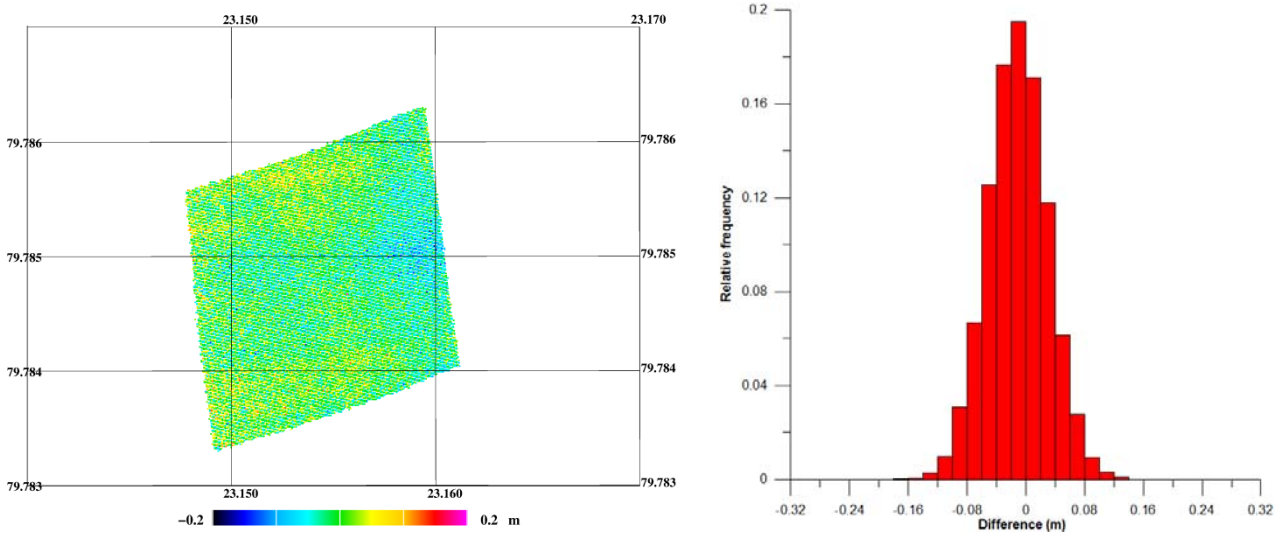


Figure 11: Cross-over differences and associated histograms from Austfonna ice cap

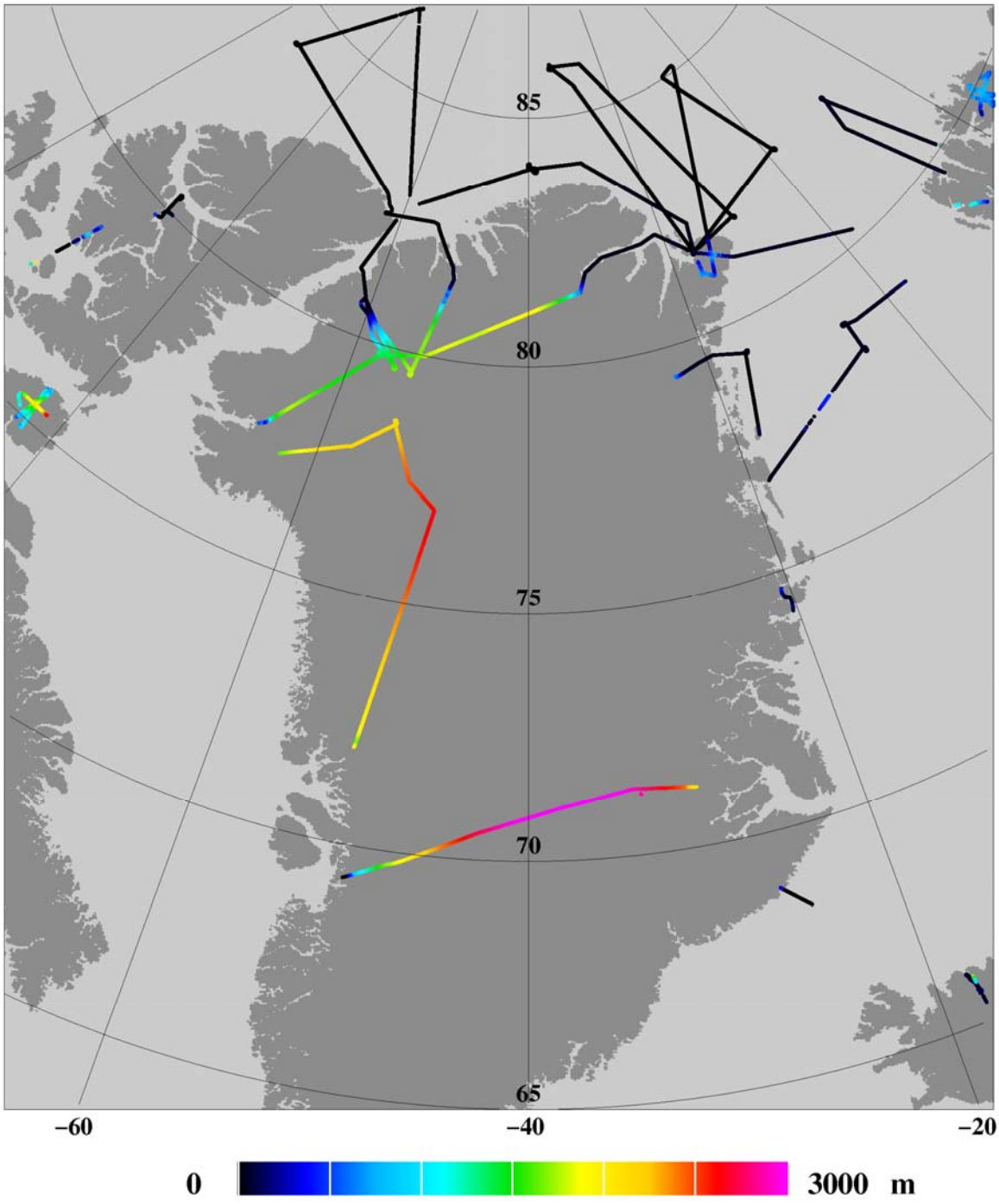


Figure 12a: Processed ALS elevations wrt WGS-84 reference ellipsoid. Missing sections are mainly due to low clouds and fog.

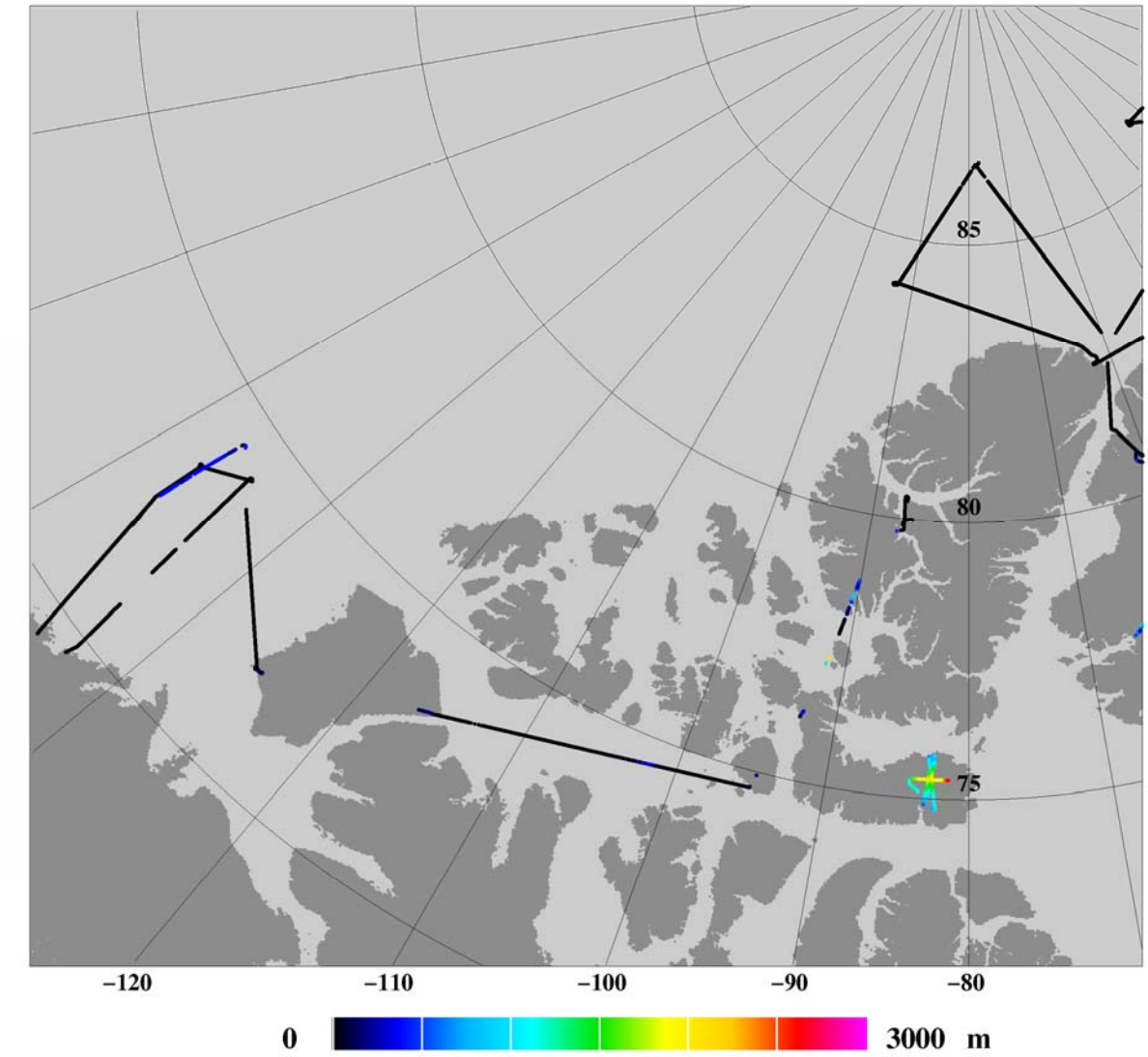


Figure 12b: Processed ALS elevations wrt WGS-84 reference ellipsoid –western part of campaign area. Missing sections are mainly due to low clouds and fog.

5.4 ASIRAS

The ASIRAS radar operates at 13.5 GHz with footprint size 10 m across-track and 3 m along-track at a standard flight height of 300 m. An overview of the acquired ASIRAS log-files together with start/stop times, range window and number of pulses are listed in Appendix 5.

5.4.1 CryoVEx 2014 ASIRAS processing results

The ASIRAS processing of the CryoVex 2014 data is analogous to the concepts already presented in Helm et al. (2006). The full data set was processed with ESA's processor version ASIRAS_04_03. A summary of the processing is given in Appendix 12 together with plots of every single profile. A

couple of tests were applied to address datation issues and to show the quality of the Level_l1b product. In general the data shows no datation errors and in most cases good quality, however in some specific areas the re-tracked elevation shows a lack of quality mainly due to the performance of the re-tracker. Especially in areas with several layers in the snow/firn, e.g. the perculation zone on ice sheets and some sea ice areas, results are in-conclusive with the OCOG re-tracker. Similar results were obtained and highlighted in former reports (e.g. Helm et. al, 2006; Stenseng et al. 2007) and are not replicated in this report, since the implemented OCOG re-tracker has not changed. The OCOG re-tracker was developed to give a quick and rough estimate of surface elevation and not to be as precise as possible. It is up to the user of the data to apply different re-tracker algorithms instead of the OCOG.

5.4.2 Runway over flights and comparison with ALS-DEM

Calibration of ASIRAS surface heights with respect to surface heights obtained by ALS, is performed by overflights of a surface, where both the radar and the laser are known to reflect at the same surface. Such measurements are typically obtained by overflights of runways. The runway overflights performed during CryoVEx 2014 are as follows:

- 17-03-2014 DOY 76 Akureyri
- 23-03-2014 DOY 82 Sachs Harbour
- 26-03-2014 DOY 85 CFS Alert
- 29-03-2014 DOY 88 Station Nord
- 28-04-2014 DOY 118 Akureyri
- 03-05-2014 DOY 123 Station Nord

Figure 13a shows the laser scanner elevation model of the Alert runway including the ASIRAS profile (black line). Gaps in the line represent areas where the roll angles are larger than 1.5°. This data was excluded from the analysis. In figure 13b the comparison of the Alert overpass with the ALS-DEM is shown. The black line in the upper panel shows the ALS elevation, whereas the dark gray line shows the ASIRAS elevation. The light gray line shows the roll angle. A difference of 3.80 +/- 0.24 between the elevations is determined with the OCOG retracker. The lower left panel shows the variation of the difference around the median value. Statistics of this variation is shown in the histogram. This offset was not applied in the final ASIRAS level_1b processing as it is dependent on the choise of re-tracker, thus a runway calibration should be carried out for each re-tracker used. Table 7 lists the successful runway overflights and the calibration results. Unfortunately coincident ASIRASand ALS data are only obtained for runway calibration in three cases, from March 23 and 26 and April 28.

Profile	Site	Start time	Stop time	Offset (m)	Stddev (m)	ALS qual.	ASIRAS qual.
A140323_05	Sachs Harbour	67898	67918	3.84	0.12	Bad (12%)	Good/offtrack!
A140326_08	CFS Alert	70560	70599	3.80	0.24	Good	Good/offtrack
A140428_00	Akureyri	43866	43891	3.75	0.07	Okay (55)	High roll

Table 7. Runway passes

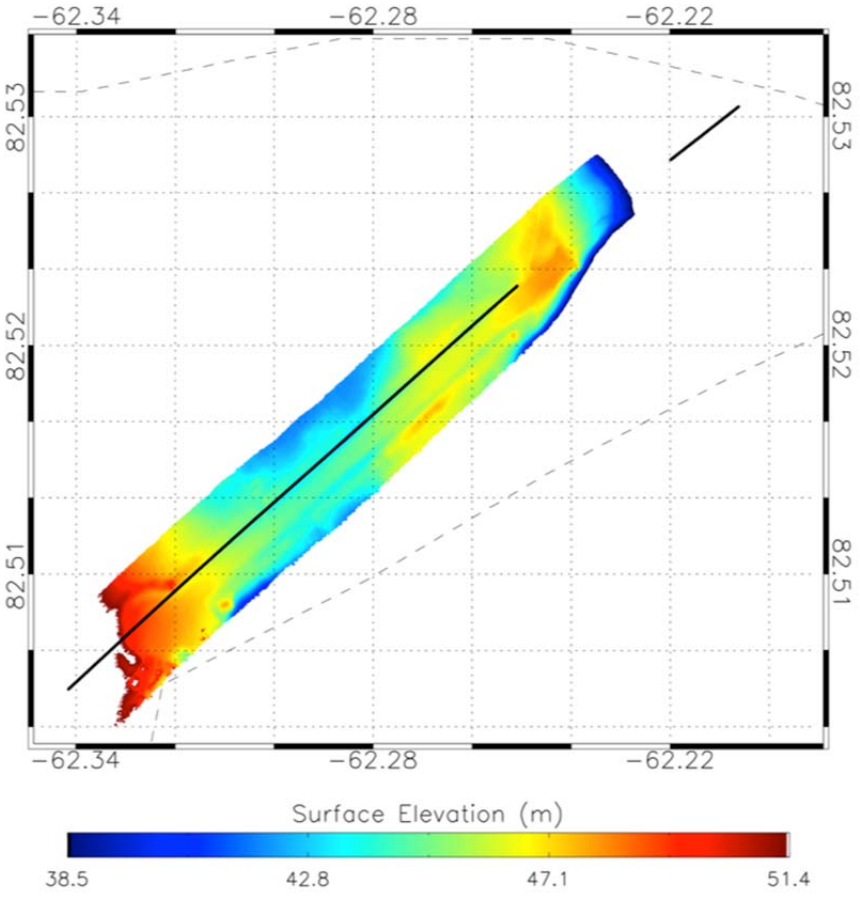


Figure 13a. Laser scanner elevation model of runway in Alert

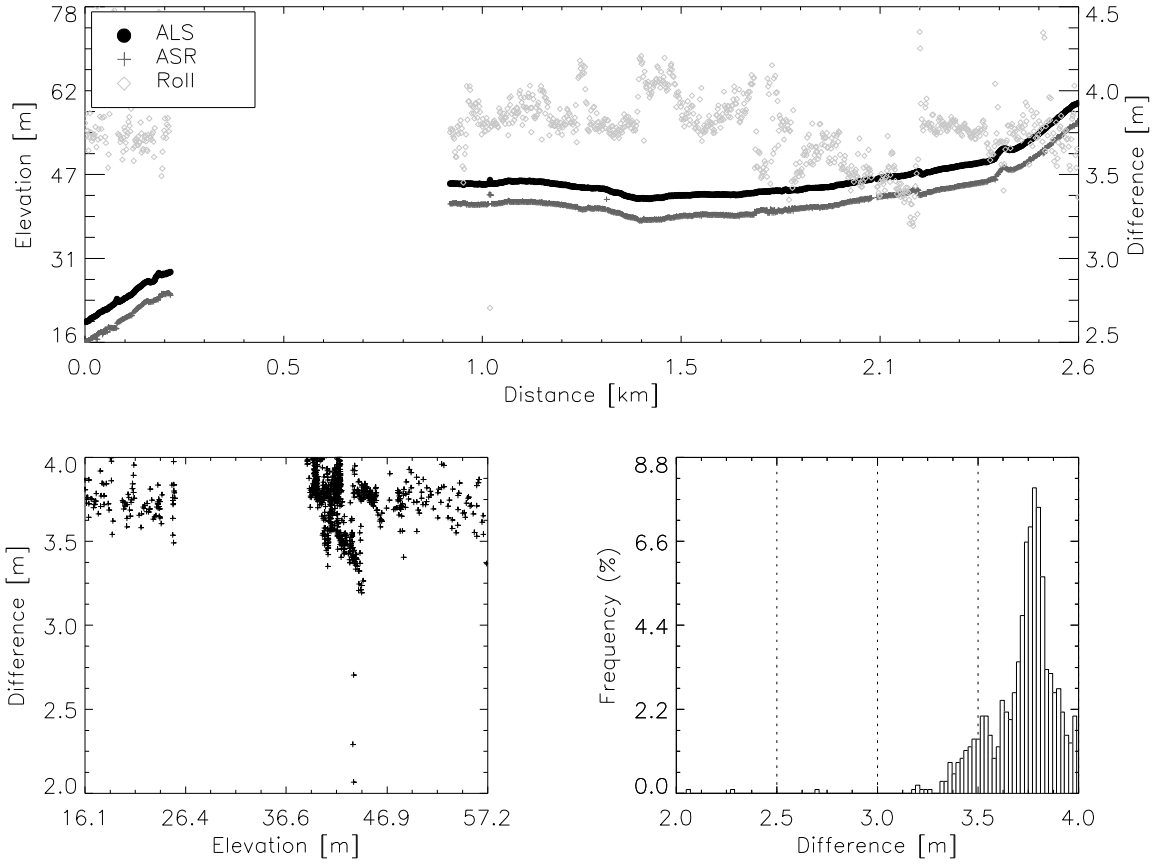


Figure 13b. Comparison of ALS and ASIRAS elevations over runway. Top shows ALS elevation in black dots, ASIRAS elevation in dark grey crosses and the light gray diamonds show difference between ALS and ASIRAS elevation. Bottom shows variation of the difference and its statistics.

5.4.3 Corner reflector over flights

Throughout the campaign there have been overflights of the corner reflectors (CR) put out at the validation sites. The positions of all the corner reflectors can be found in Table 8. All CR-passes were analyzed and close passes are listed in Table 9. An example of Level_1b processed ASIRAS data of the CR pass over the Devon validation site is shown in Figure 14. The 14DEV1 corner reflector was "hit" at 54800.3s and appears after processing as a point target roughly 1 m above the surface. A subsurface layer can also be identified roughly 1m beneath the surface in this profile.

At Austfonna CR were raised at three locations. All of which were observed by ASIRAS for the first time in the CryoVex campaigns. At the second location, AUST2, extra CR were placed north and south of the main CR (spacing ~30m) to ensure close approach and successful "hit" of the site. Similar outline of CRs has been used on Devon for past and present campagns and this has proved very usefull.

On sea ice CR were surveyed in the Beaufort Sea at two sites (AW1/2) and also north of Greenland at the CryoVEx camps (CryoVEx1/2), more detail is found in Section 6.1. Both AWS CR show large offset. These were overflown visually due to the drift of the sea ice. This is less accurate than using fixed coordinates, hence, the larger offsets.

Table 8: Positions of corner reflectors installed in CryoVEx 2014

CR	Latitude	Longitude	Ground elevation* (m)	Height (m)
AW1	72.5512	-136.961	not available	not available
AW2	73.499	-136.998	not available	not available
CryoVEx1	83.97233	-39.506833	not available	not available
CryoVEx2	~86.00	~-34.00	not available	not available
DEV east	75.338032	-82.677623	1796.209 a.s.l.	1.1
DEV Summit	75.338230	-82.678117	1796.478 a.s.l.	1.2
DEV west	75.338468	-82.678786	1796.762 a.s.l	0.94
AUST 1	79.73360	22.41776	365.9	1.26
AUST 2n	79.78494	23.15546	673.25	1.28
AUST 2	79.78467	23.15578	673.25	1.47
AUST 2s	79.78440	23.15598	673.25	1.41
AUST 3	79.81473	23.70998	812.26	1.23

*WGS-84

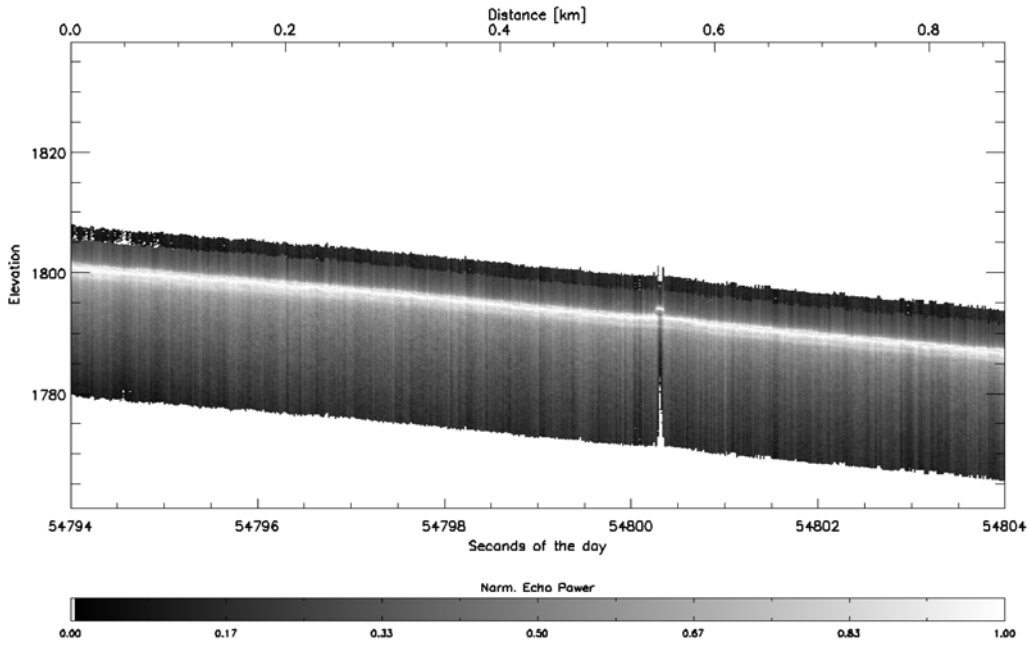


Figure 14. Successful CR pass over the validation site on the Devon Icecap after ASIRAS processing. The CR is seen as point target roughly 1 m above the surface.

Table 9. CR passes

CR	Profile	Closest approach	Time	In the data?
14DEV1	A140506_00	3.10	54800.3	Yes
14AUST1	A140503_00	10.74	33478.9	Weak
14AUST2	A140503_00	3.71	33733.7	Yes
14AUST3	A140503_00	1.33	33909.2	Yes
14CV1	A140329_01	23.52	56423.9	Yes
14CV2	A140330_02	307.70	56768.2	Weak
14AWS1	No data			
14AWS2	A140321_03	1171.83	64011.4	No

5.5 Vertical images

To complement the analysis of ALS and ASIRAS data over sea ice high resolution images are collected along the flights. Two cameras were used for this purpose.

Two nadir-looking cameras were mounted next to the ALS instrument in the rear baggage compartment, see section 3. A GoPro camera in time lapse mode collected photos at a 2 second interval. Next to this a backup uEye webcam was installed also acquiring images at 2 second interval but with slightly lower resolution. Both cameras were remotely controlled and time tagged using the internal PC/camera clock. By combining the time-tag of the images with GPS data the images can be geo-referenced along the flight lines. An overview of the properties of the cameras is given in Table 10 and examples are shown in Figure 15 and 16.

Table 10: Overview of camera types and settings.

Camera type	View	Interval (sec)	Resolution (pixels)	Image size (MB)	Software program
Webcam	Nadir-looking	2	1280x1024	~5	uEye
GoPro	Nadir-looking	2	2592x1944	~1.6	GoPro app

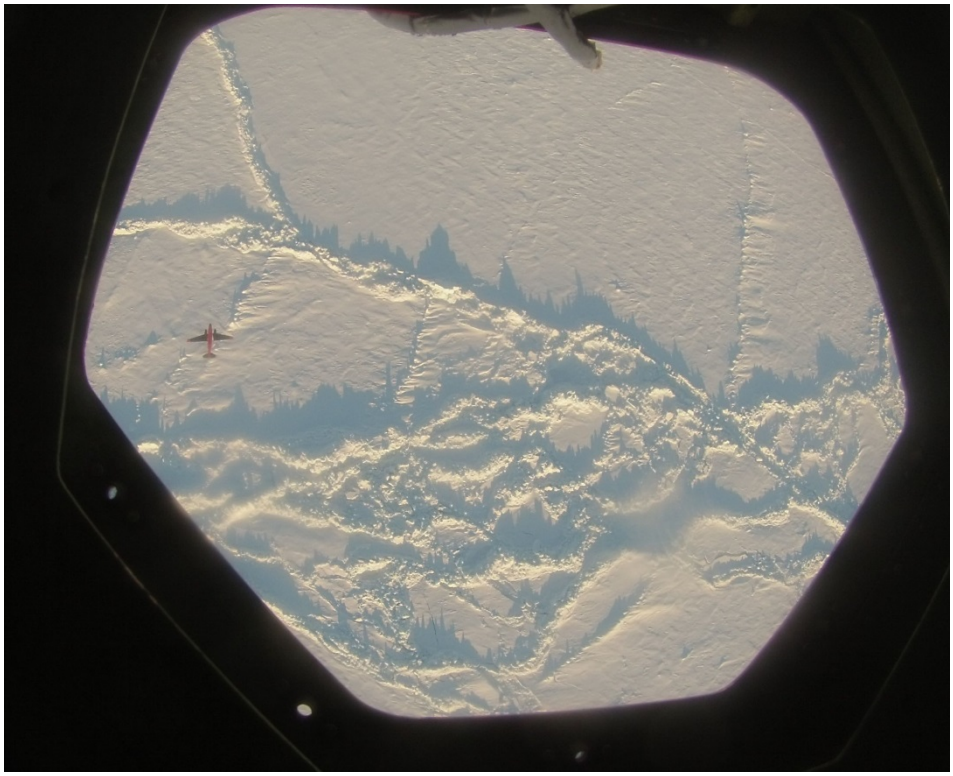


Figure 15: Example of nadir-looking image from GoPro camera of Kenn Borek Basler aircraft carrying EM bird

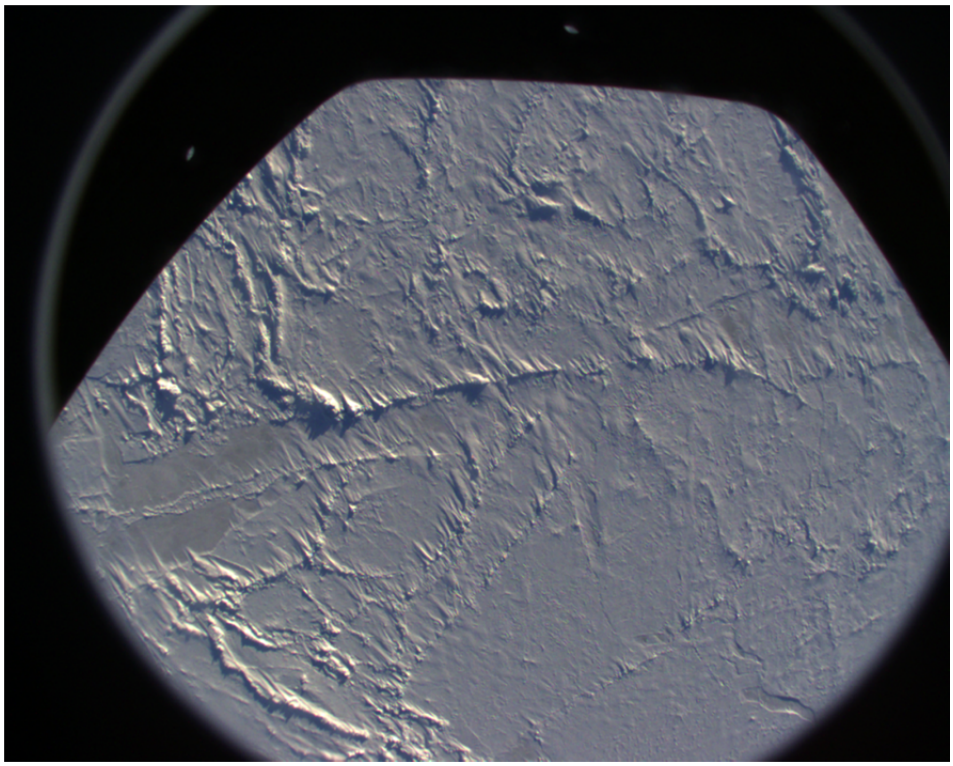


Figure 16: Sample from lower resolution webcam of sea ice north of Greenland.

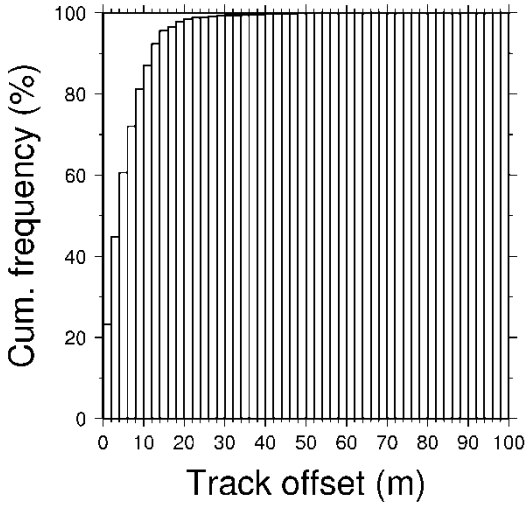
6 Calibration and Validation sites

During the CryoVEx 2014 campaign a total of 13 CryoSat-2 ground tracks were flown covering various distances. Several of the tracks were aligned with the ground validation sites. The key sites of the CryoVEx 2014 campaign are described below, see figure 1-2 for flight tracks. Details of the sea ice ground experiments together with AEM measurements are reported separately (Haas et al. 2015).

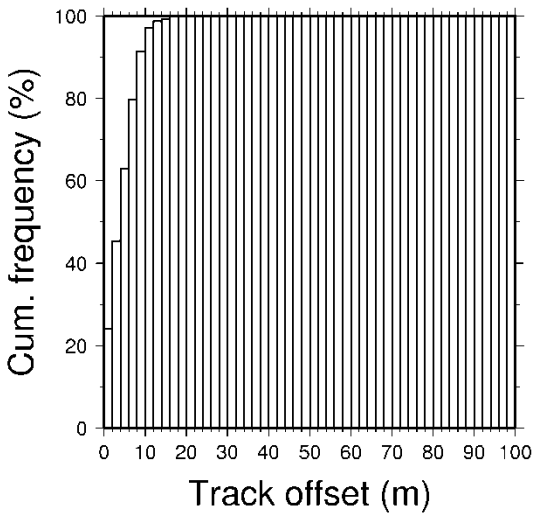
All airborne data acquisitions along CryoSat-2 ground tracks are listed in Table 11, together with information of CryoSat-2 orbit numbers, passage time, mode and data acquisition.

For coincident flights the aircraft navigation accuracy is important in order to track the same sea ice. The data acquisition along the correct flight lines are secured by a DTU Space in-house developed real-time software, which both allows pilot and scientists to monitor the flight locations in real time, relative to a planned track. The horizontal track accuracy for four flights (March 26 and 31 and May 6 and 9) following CryoSat ground tracks, are given in Figure 17 (a-d).

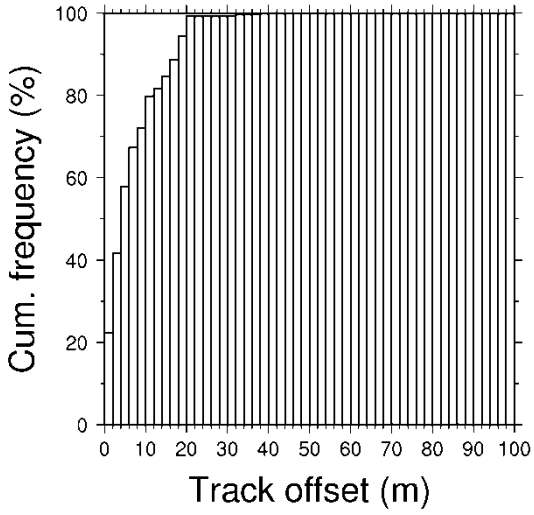
The tracks are flown in good conditions with constant manual adjustments from the pilots, which gives the maximal accuracy of the flight tracks – 95% of the track is closer than 10-15 m. The flights on May 6 and 9 were flown over sloping terrain and for May 6 in windy conditions and still the accuracy is approximately 20 m. For transit flights and non-key sites the aircraft's autopilot is used only with minor correction by the pilots; this provides an accuracy at the 30 m level as described for previous CryoVEx campaigns (see Skourup et al. 2012, and 2013)



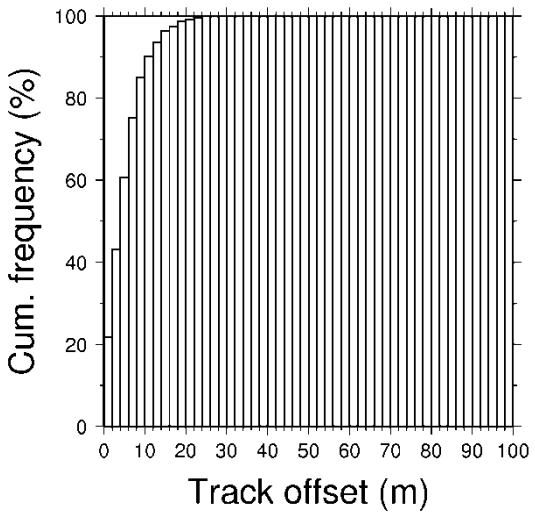
a) 26-03-2014, DOY 085 CryoSat track 21021 95% at 14m



b) 31-03-2014, DOY 090 CryoSat track 21090 95% at 10m



c) 06-05-2014, DOY 126 Devon Ice Cap 95% at 20m



d) 09-05-2014, DOY 129 EGIG line 95% at 14m

Figure 17: Track accuracy

Hence, for shorter flights it is routinely possible to obtain a nominal track accuracy of about 10 m with the navigation equipment, thus giving the necessary navigation accuracy for "hitting" ASIRAS corner reflectors, see Section 6.2.

6.1 Sea ice

In total, nine CryoSat-2 underflights were performed over sea ice, as outlined in previous figures and Table 11. Data was acquired in the Arctic Ocean north of Western Canada, north of Alert, north of Station Nord and north of Svalbard. These areas represent different sea ice types and settings, with very rough ice north of Greenland and thinner ice north of Western Canada and Svalbard.

Table 11: Overview of airborne data acquisitions along CryoSat-2 ground tracks, together with information of CryoSat-2 orbit numbers, passage time, mode and data acquisition.

Sea ice	Land ice	Location	Airborne activity	CryoSat-2 Orbit #	CryoSat-2 passage Date and time (Time given as hh:mm UTC)	CryoSat-2 Mode	Distance Covered (km)	ASIRAS	ALS	YU-AEM	NASA IceBridge	In situ
X		Beaufort Sea	21-03-2014	20942	21-03-2014 14:57	SAR	480	X	X	X		X
X		North Canada	25-03-2014	21006	26-03-2014 00:56	SARIn	130	X	X			
X		Lincoln Sea	26-03-2014	21011	26-03-2014 09:06	SAR	470	X	X	X	X	
X		Lincoln Sea	26-03-2014	21021	27-03-2014 01:42	SAR	265	X	X	X	X	
X		Nares Strait	28-03-2014	21034	27-03-2014 23:13	SARIn	130	X	X			
	X	GrIS	28-03-2014	21048	28-03-2014 22:23	LRM/SARIn	225	X	X			
X		Wandel Sea	30-03-2014	21067	30-03-2014 05:43	SAR	485	X	X	X		
X		Wandel Sea	31-03-2014	21081	31-03-2014 04:52	SAR	290	X	X	X		
X	X	Wandel Sea/Flade Isblink	31-03-2014	21090	31-03-2014 19:48	SAR	475	X	X	X	X	
X		North Svalbard	02-05-2014	21544	02-05-2014 02:33	SAR	270	X	X			
	X	Austfonna	03-05-2014	21798	19-05-2014 14:43	SARIn	80	X	X			X
	X	Austfonna	03-05-2014	5671	04-05-2011 08:17	SARIn	50	X	X			X
	X	Austfonna	03-05-2014	5700	06-05-2011 08:15	SARIn	25	X	X			X
	X	Devon	06-05-2014	10976	03-05-2012 21:30	SARIn	115	X	X			X
	X	Devon	06-05-2014	10810	22-04-2012 11:07	SARIn	95	X	X			X
	X	GrIS	07-05-2014	21627	07-05-2014 19:56	LRM/SARIn	560	X	X			
	X	GrIS	08-05-2014	21706	13-05-2014 06:25	LRM	320	X	X			

A comparison of CryoSat-2 Level 2 using baseline C and B processors for a track crossing the Arctic Ocean (orbit 21090) on March 31, 2014, is given in Figure 18. In the non-filtered product, Baseline C is showing a large number of outliers (upper plot). These are filtered out (24% of the data) by using the flag in the data product for height errors (bottom plot). No data is filtered out in the Baseline B product, even though there are many negative outliers due to locking on off-nadir leads.

CryoSat-2 height data from baseline C and B (red and blue) is plotted together with near-coincident ALS data (green) in Figure 19 (ALS data gathered 19:04-20:41, CS-2 at 19:48 UTC). To approximate the sea surface height a geoid model (ArcGP) has been removed from the elevations. In general baseline C compares well with ALS data, where the laser measurements are 10–20 cm above the CryoSat-2 ice elevations. This difference is most likely due to the snow layer on top of the sea ice. There is a bias of about 1 m using baseline B product, which is not present in baseline C. In addition, the outliers have not been flagged, see above. The data is available within the ESA CryoVal-SI project.

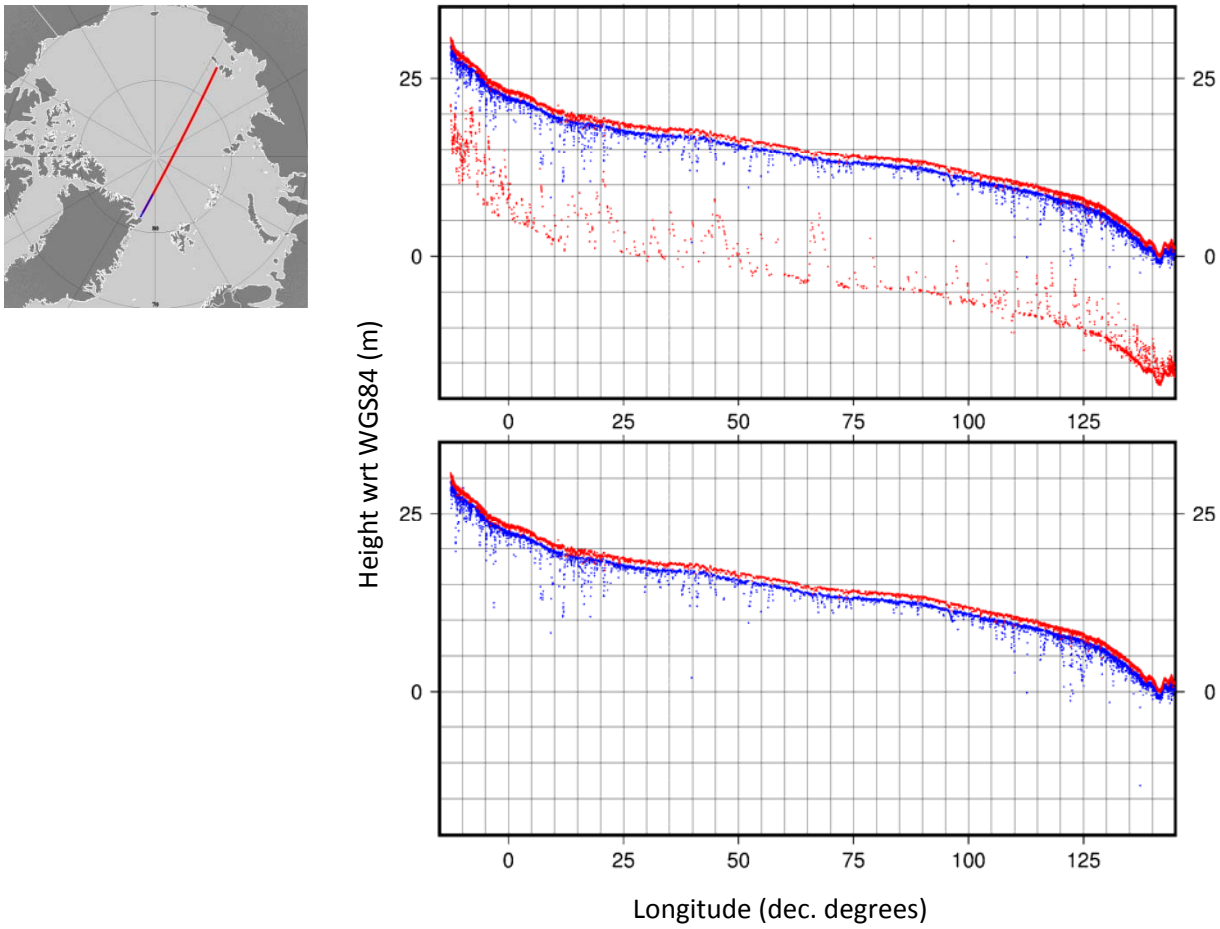


Figure 18: CryoSat-2 L2 ellipsoidal heights from baseline C (red) and baseline B (blue) along orbit 21090, March 31, 2014. The non-filtered data is shown in the upper plot, whereas data flagged as height errors is filtered out in the lower plot.

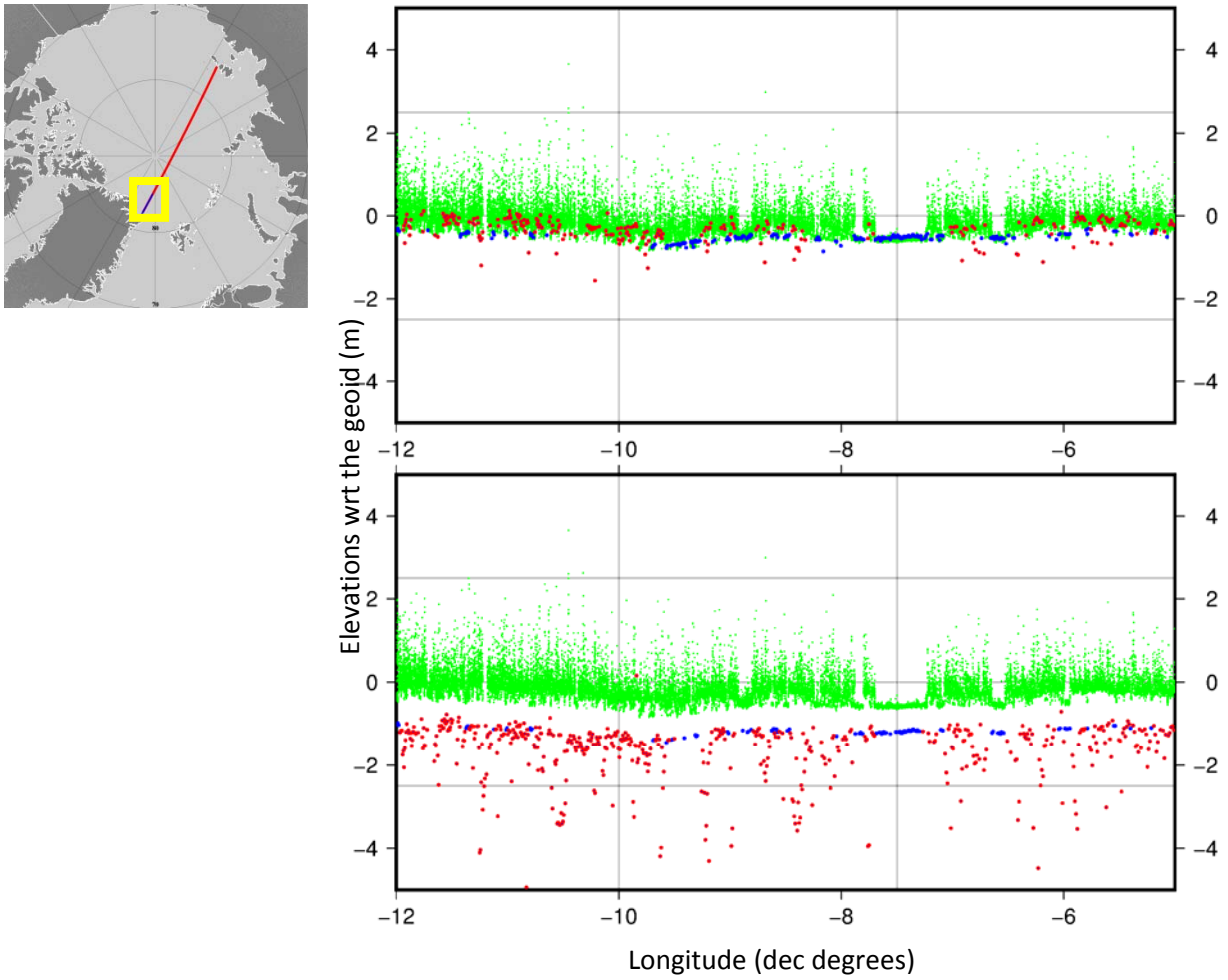


Figure 19: CryoSat-2 L2 elevations (blue and red) plotted together with ALS elevations (green) along orbit 21090.CryoSat-2 data has been classified as either lead (blue) or sea ice (red). Baseline C processing is shown in the upper plot, whereas baseline B is shown in the lower plot. The exact time of CryoSat-2 passage is at -9.615 dec. degrees

As part of the CryoVEx campaign, the University of York Basler aircraft towing an electromagnetic sounder (AEM/EM bird) and NASA's Operation IceBridge (OIB) P-3 aircraft equipped with multiple sensors for sea ice and snow retrievals made coincident flights along CryoSat-2 ground tracks and over validations sites possible. As the Basler EM bird measures the draft of the sea ice, a comparison to the ALS and ASIRAS is very important for the freeboard to thickness conversion. The snow radar onboard NASA P-3 is valuable for snow depth information to estimate ASIRAS penetration depths.

The sea ice flights focused on two ground validation sites and several long CryoSat-2 under-flights coordinated with Basler EM-bird observations. The ground sites were located in the Beaufort Sea and in the eastern part of the Lincoln Sea north of Greenland.

The Beaufort Sea experiment consisted of four sites (AW1-4) organized by the ONR (US Office of Naval Research), see Figure 20. Sites AW1 and AW2 were surveyed both by T-O ASIRAS/ALS and Basler EM-bird on March 21 and 23 along with CryoSat-2 under-flight on March 21. Good conditions were met on March 21 but more cloudy weather limited the Basler operations and ALS acquisition on March 23.

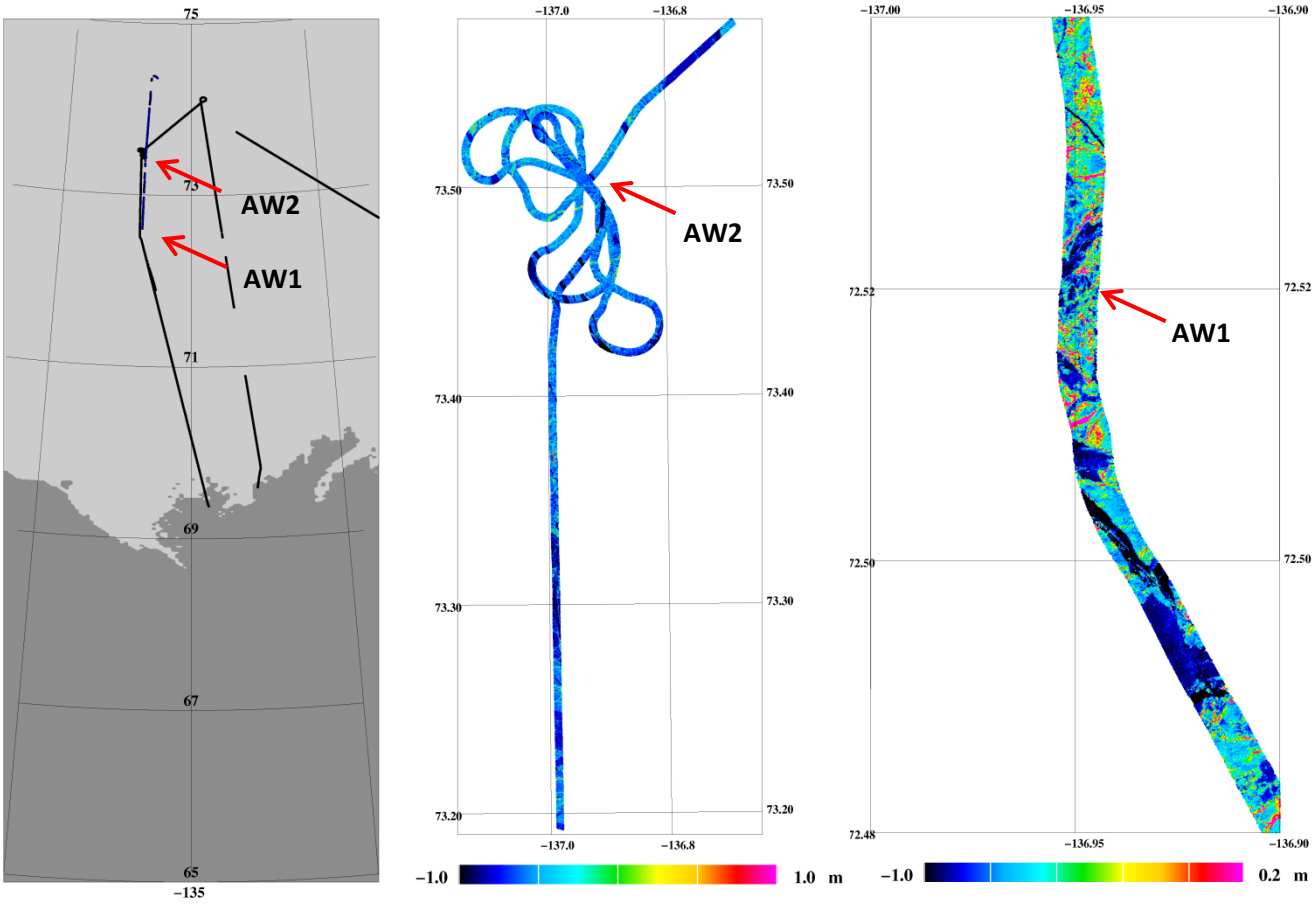


Figure 20. Location of flight lines near ONR sea ice sites AW1 and AW2. Center: Survey near AW2, March 21 ALS elevations relative to local geoid (Arctic Gravity Project geoid model). Right: Acquired ALS elevation data near AW1.

The Lincoln Sea site – a dedicated CryoVEx 2014 ESA activity – consisted of a main site surveyed on March 29 on transit from CFS Alert to St. Nord and a secondary site further north. The northern site was surveyed on March 30 together with surveying CryoSat-2 tracks. Figure 21 shows the survey location in detail.

In between camp over-flights, coordinated CryoSat-2 under-flight from CFS Alert was conducted on March 26. This flight was coordinated between 3 parties: Basler EM bird, T-O ASIRAS/ALS and also the NASA OIB P-3 measurements, Figure 22 shows pictures of the EM Bird under the Basler aircraft before take off and thethe P-3 aircraft used by OIB. A similar formation flight with these three parties was carried out from St. Nord on March 31. Here the exact time of CryoSat-2 was met by both the

Basler and T-O (P-3 limited by Thule AB opening hours though). In addition the Basler and T-O surveys were exactly coincident in space and time for most of the flight by lowering the T-O airspeed - a true tandem flight.

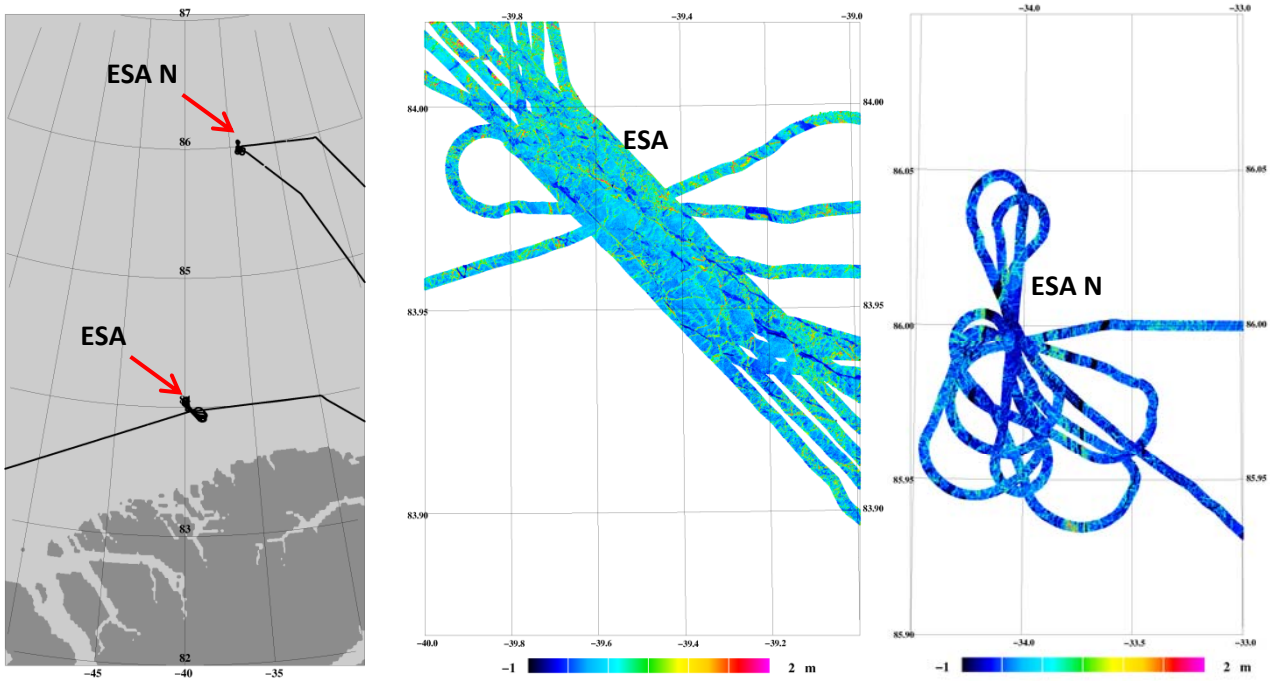


Figure 21. Location of flight lines of the ESA sea ice camps. Center: Survey March 29 ALS elevations relative to local geoid(Arctic Gravity Project geoid model). Right: Acquired ALS elevation data near the northern site, March 30.

Figure 22: Mounting of the AEM during take-off and landing (left) and NASA P-3 aircraft (right).

A sea ice survey north of Spitsbergen on May 2 was part of the second campaign period. With this flight the campaign almost reached 180 degrees coverage of the Arctic Ocean sea ice conditions in spring 2014. This particular flight surveyed a CryoSat-2 track and repeated a survey line from the CryoVEx 2011 campaign.

6.2 Land ice

Measurements of land ice included flights of the Greenland Ice Sheet (the EGIG line and CryoSat- 2 ground tracks 21627 and 21706), Austfonna and Devon ice caps. Flights (Devon and Austfonna ice caps) were coordinated with scientists taking measurements of snow and ice properties on the ground along CryoSat-2 ground tracks and transects of special glaciological interest. No *in situ* measurements were taken along the EGIG line, but airborne measurements are still important to monitor changes in the ice sheet mass balance.

Corner reflectors (CR) were placed by the ground teams at Austfonna and Devon ice caps. The reflectors are used as a reference point to validate the penetration of the radar signal in the upper layers of the ice cap, and to check the timing of the ASIRAS radar. An overview of the position is given in Table 8. To overfly the corner reflectors demands very precise navigation as the reflector has to be within ±5 m of the aircraft ground track due to the across track footprint of the ASIRAS. The necessary navigation accuracy for hitting ASIRAS corner reflectors on the ground is obtained as decribed in the beginning of Section 6. Furthermore, the real-time display of the ASIRAS radar indicates whether the reflector is “hit” at the time of overflight.

The cooperation between the ground and airborne teams was excellent, and contact by iridium phone with the ground teams prior to flights have been invaluable to receive updates on weather conditions and positions of corner reflectors. An overview of the Austfonna and Devon ice caps are given below. The location of the flights of the Greenland ice sheet is shown in Figure 1.

6.2.1 Austfonna ice cap

The Austfonna ice cap tracks were flown on May 3, 2014. Due to the limited flight time selected lines were prioritized; one CryoSat-2 ground track with detailed mapping with parallel lines (mow-the-lawn pattern) next to part of the line and ASIRAS validation lines repeated from previous CryoVEx campaigns. Figure 23 shows ALS elevations in colors and in black the CryoSat 2 footprint locations are marked. This example demonstrates the importance of flying a mow-the-lawn pattern along parts of CS-2 tracks in SARIn mode, to get overlapping data due to off-nadir location of CS-2 observations caused by topography.

The survey was delayed several days to wait for proper weather conditions. An attempt to survey Austfonna was done on May 2 but low clouds prohibited surveying of the ice cap and sea ice measurements were done instead. On May 3 the weather was fairly good with a few low clouds in northern part. Therefore, a shortening of the northern part of a few lines ensured flight time for the southern part, which had priority due to the recent large changes of this part of the ice cap. ASIRAS data were collected during the entire flight, and although the laser scanner does not penetrate clouds, the cover was rather thin and data were gathered over most of the flight lines.

At the Austfonna ice cap the ground team from University of Oslo and Norwegian Polar Institute had put up three corner reflectors (AUST1-AUST3) prior to the flight, for positions see Table 8. Two of the corner reflectors were within few meters of the flight track, see Table 9. Steep terrain limited the navigation accuracy near the first CR (AUST1)and the return signal is weak. Note that, similar to the procedure at Devon, three reflectors were raised at AUST2 as mentioned in section 5.4.3 – this ensured successful ASIRAS data acquisition of CRs at Austfonna for the first time.

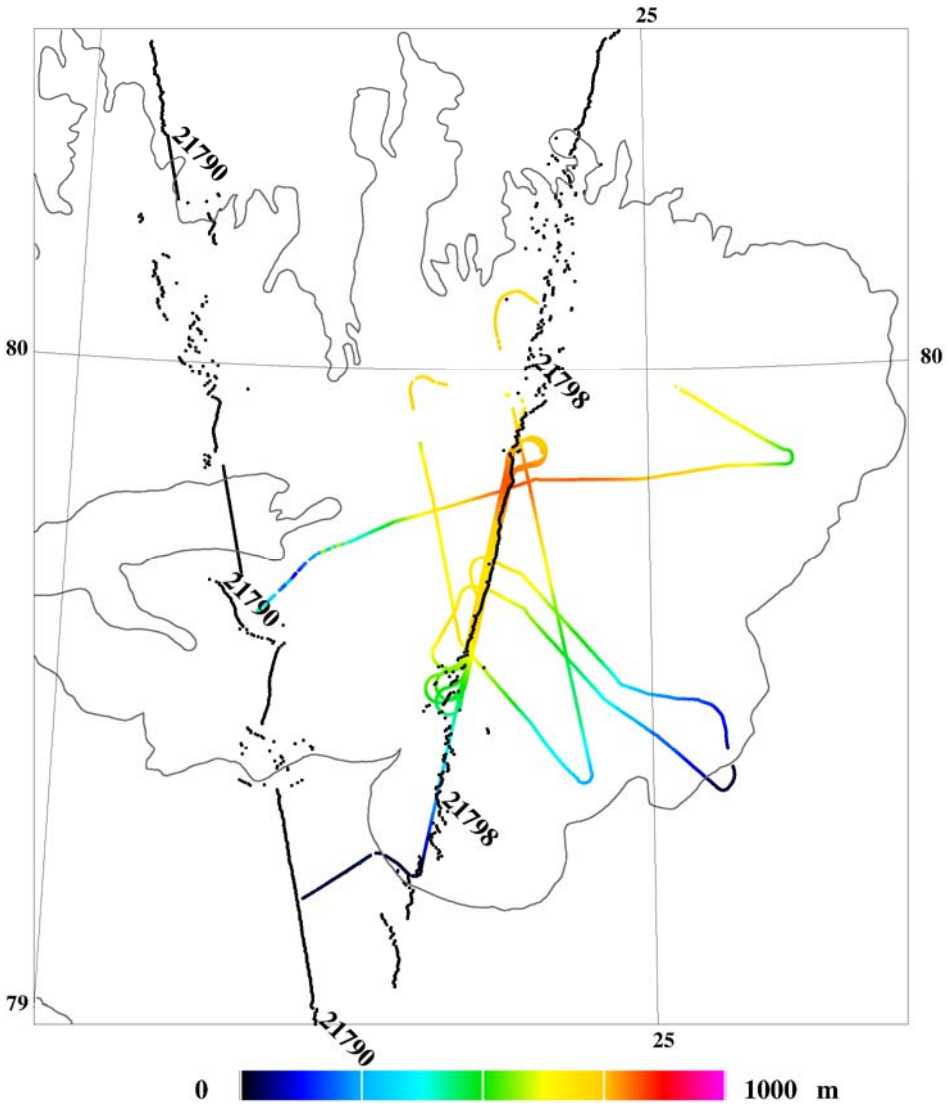


Figure 23: CS-2 level 2 baseline B tracks (black dots) overlaid ALS elevations at Austfonna Ice Cap

6.2.2 Devon ice cap

The survey of Devon ice cap was carried out on May 6, 2014 from Thule AB. The ground team from the Geological Survey of Canada and the University of Alberta was already established in a camp near the summit (see photo) and the corner reflectors were in place. A CryoSat-2 track and repetition of previous validation lines were flown – one survey line over the Belcher outlet glacier had to be cancelled due to wind and low clouds. The condition for the survey was fair with some challenges due to strong winds but turned out to be the best choice during the week with permission to use Thule AB. The CR at Devon Summit show a good response in the ASIRAS data, see also Figure 14 Section 5.4.3.

A second flight over Devon to map a part of a CryoSat- 2 track further west of the first survey in more detail (similar to the Austfonna “mow-the-lawn”) was scheduled for May 7. Strong winds and clouds prohibited this and since the forecast for the rest of the week looked worse it was cancelled and the team continued south with surveying of a CryoSat-2 track on the Greenland ice sheet.

Figure 24: Summit camp on Devon ice cap (Photo: L. Sandberg Sørensen).

6.2.3 Greenland Ice Sheet

On the Greenland Ice Sheet, the EGIG line and CryoSat- 2 ground tracks 21627 and 21706 were surveyed. Data from the EGIG line will add another dataset to the CryoVex timeseries of acquisition reaching back to 2003.

CryoSat orbit 21627 (May 7 2014, see Table 11) was surveyed within a few hours of satellite data acquisition and a preliminary comparison of elevations to aircraft ALS is shown in Figure 25. Here a seach radius of 500 m and time span of plus minus 10 days are used to find coincident data point in time and space. The mean elevation difference is 0.5 m with a std. of 3.43 m. The ALS data giving heigher elevations than the CryoSat radar data as expected due to the penetration of the radar signal in cold and dry snow/firn. Also note that south of approximately 74N the data is from SARin mode causing the off nadir track location of the footprints over sloping terrain.

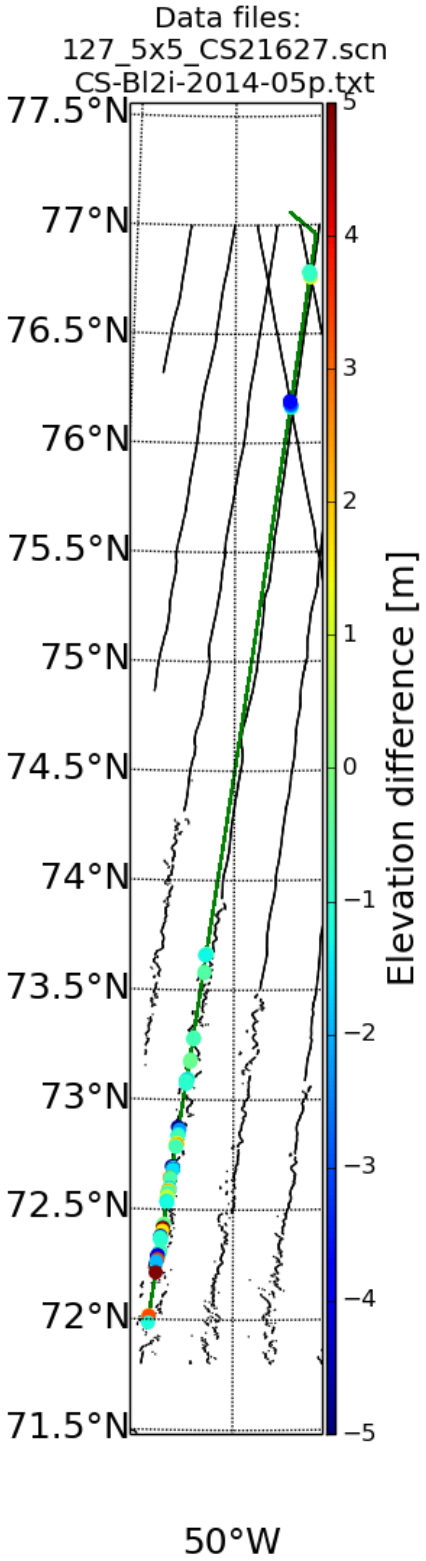


Figure 25. Elevation differences from CryoSat minus ALS elevations orbit 21627 May 7 2014 – colored dots. In black is shown the satellite ground tracks, note that in SARin the footprints do not follow a straight line. The ALS locations are shown in green.

7 Conclusion

The CryoVEx 2014 airborne campaign has been a success. In general, the weather was good, which allowed data acquisition from all validation sites as well as most transit flights. Coincident ALS, ASIRAS, and photography have been gathered along 13 CryoSat-2 ground tracks covering different sea ice conditions, parts of the Greenland ice sheet, as well as the local ice caps Devon and Austfonna. Whenever possible the tracks were timed to match the CryoSat-2 passage times, however this was hampered by limited airport opening hours, e.g. at CFS Alert.

Coincident sea ice flights along CryoSat-2 ground tracks with University of York's Basler aircraft towing an electromagnetic sounder and NASA's IceBridge aircraft P-3, equipped with multiple sensors for sea ice and snow retrievals, were performed whenever possible in the Beaufort and Lincoln Sea and north of Greenland.

Flights on the ice caps (Devon and Austfonna) were coordinated with scientists taking measurements of snow and ice properties on the ground along CryoSat-2 ground tracks and transects of special glaciological interest. In addition, the ground team erected several corner reflectors along the validation lines. The reflectors are used as a reference point to validate the penetration of the radar signal in the upper layers of the ice cap, and to check the timing of the ASIRAS radar. In addition a mow-the-lawn pattern was surveyed over part of the Austfonna ice cap. Special focus of CryoVEx 2014 was the over-flights of the CryoVEx camps off north Greenland and the ONR camp north of Canada where extensive ground experiments were performed.

The ASIRAS and ALS instruments worked without any major problems. Based on CR analysis and comparison to coincident ALS runway overflights it is concluded that ASIRAS level_1B data processed with the ASIRAS processor version ASIRAS_04_03 shows no datation errors and an overall good quality. The ALS data is likewise of high quality with standard deviation of less than 10 cm at existing cross-over points. The preliminary comparisons to CryoSat-2 data show the potential of the extensive dataset.

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1 APPENDIX Operator logs

DOY 76 17/3-2014 AEY-test-AEY (calm, -1-2C, sunny)

1145	Start up, scanner file
1202	Engines on
1206	Taxi
1211	Take off AEY
121745	New scanner file
1232	Runway 1000 ft
1236	Runway 1200 ft
12	Building
1243	Building
	Landing

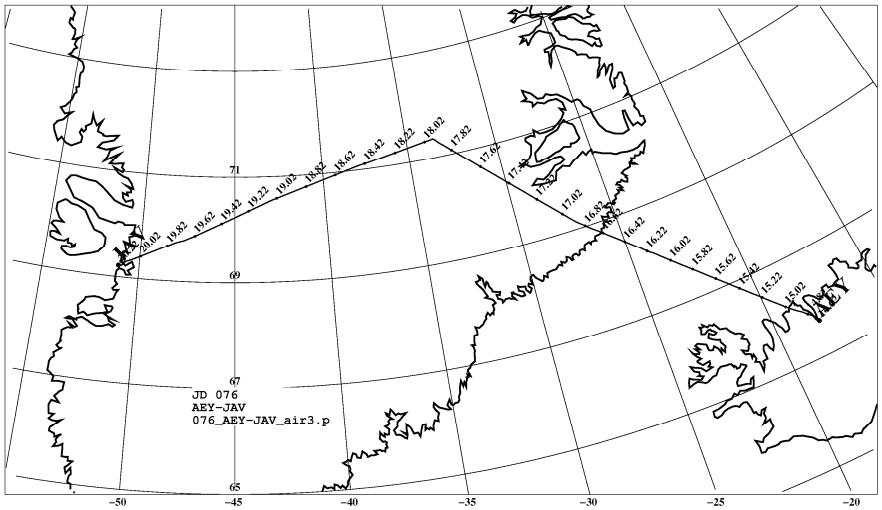
AEY-EGIG-JAV (sunny JAV, cloudy east of GRL)
EMAP ??? -45 65 77 (2012-40 65 79 -65 -15)

1436	Taxi
1440	Take off AEY
144200	Scanner sync after on/off
	OXTS diff start, PC scroll missing
1515	3000ft
1608	Decent to 1000 ft over sea ice
161130	New scanner file
162015	New scanner file
1638	Climb, end of sea ice, coast
175215	New scanner file
1757	EG6, narrow scanner swath
	Scanner stop, temp 28 (censor -18) V231
181200	New scanner file, diset
1823	EG5
1827	T41
1903	T21
190700	New scanner file
1921	T12
1938	T5
1941	T3
1944	T1
2004	End of line
2015	Landing

ASIRAS LOG

Operator Wolfram Borisch Emil Nielsen
Measurements started
Test flight in AEY with cross flight over building.
Measurements stopped
Measurements started
Calibration file: A140317_02_1.ca2
Flight over sea ice at the East coast approach
Measurements stopped - Files: A140317_00_1_00 -> _06
Measurements started
Calibration file: A140317_03_1.ca2
Event: 0 -> Waypoint EG5
Event: 1 -> Waypoint T41
Event: 2 -> Waypoint T21
Event: 3 -> Waypoint T12
Event: 4 -> Waypoint T5
Event: 5 -> Waypoint T3
Event: 6 -> Waypoint T1
Calibration file: A140317_04.ca2

Measurements stopped - Files A140317_01_1_00 -> _26

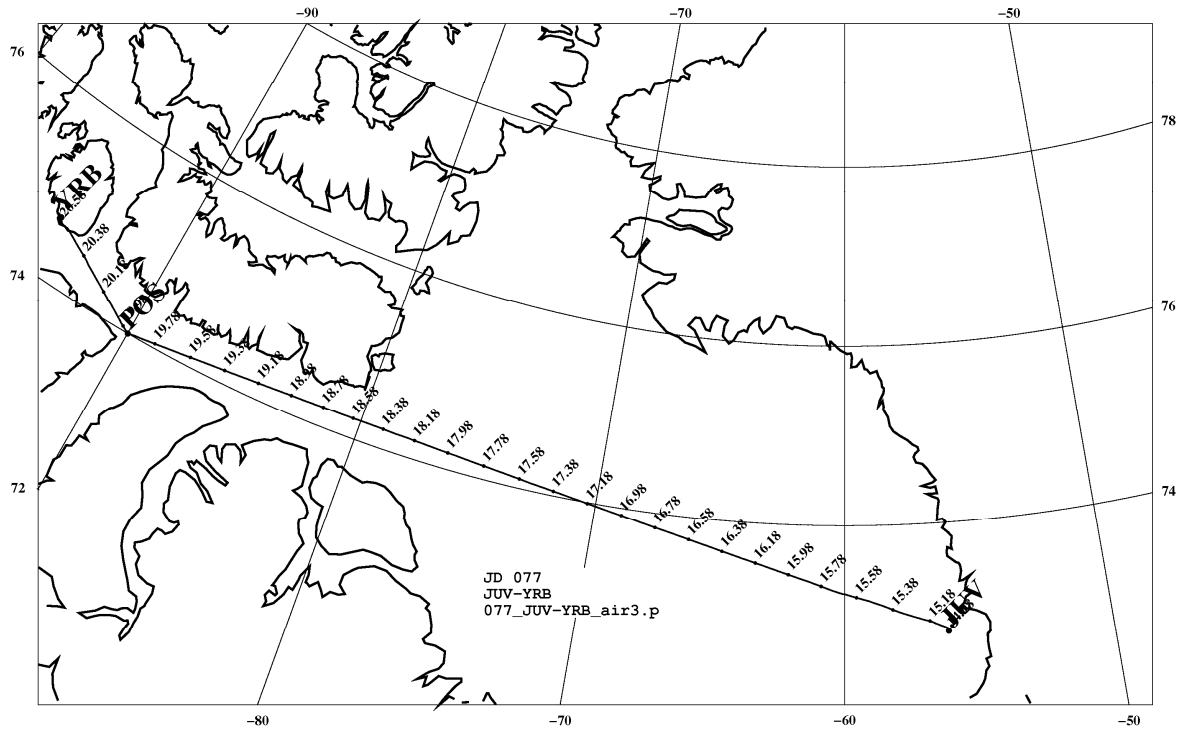


DOY 77 18/3-2014 JAV-JUV-YRB (calm, -15C, sunny JAV)

Heating off during night
120515 Start up, scanner sync, scanner temp -4, signal ok
1225 Engines on
1229 Taxi
1233 Take off JAV, scanner signal ok
1252 Scanner temp 32
1415 Landing JUV
Power on
EGI align
144500 Scanner sync
1500 Start up
JUV-YRB
1501 Taxi
1504 Take off
Few scanner returns
Restart PC and scanner, no diff
Switch to TS1 (last pulse) – better
152045 New scanner file
161500 New scanner file
171515 New scanner file
181430 New scanner file
191500 New scanner file (5 sec late start)
1952 Clouds – stop scanner log
1955 POS
2038 Landing YRB

ASIRAS LOG

Operator: EN
Measurements started
Calibration file: A140318_00_2.ca2
17:06 Switch PC from 2 to 1
File collected on PC2: A140318_00_2_00 -> _21

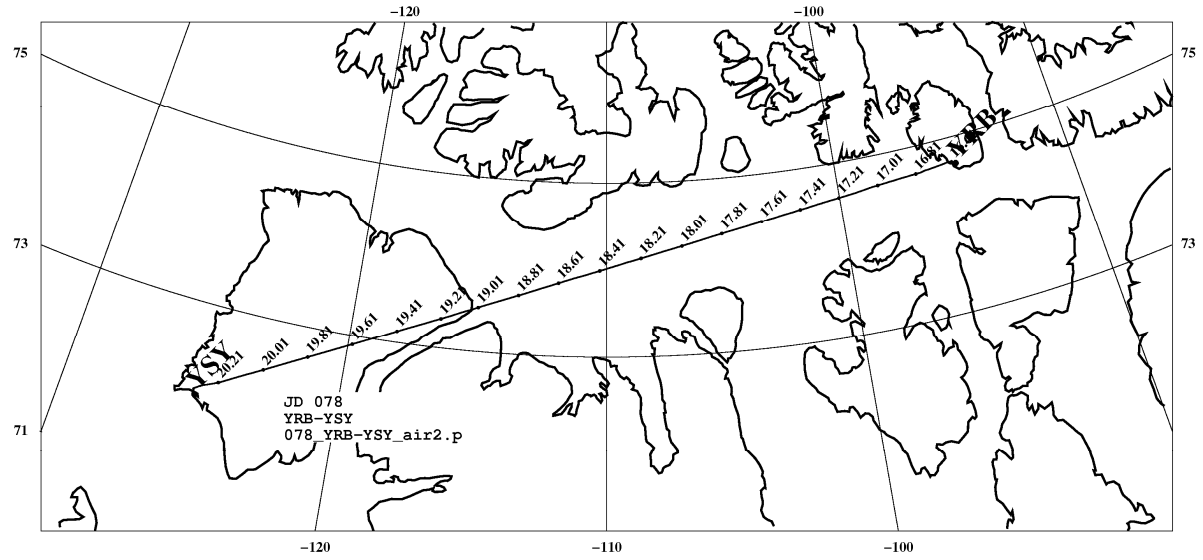


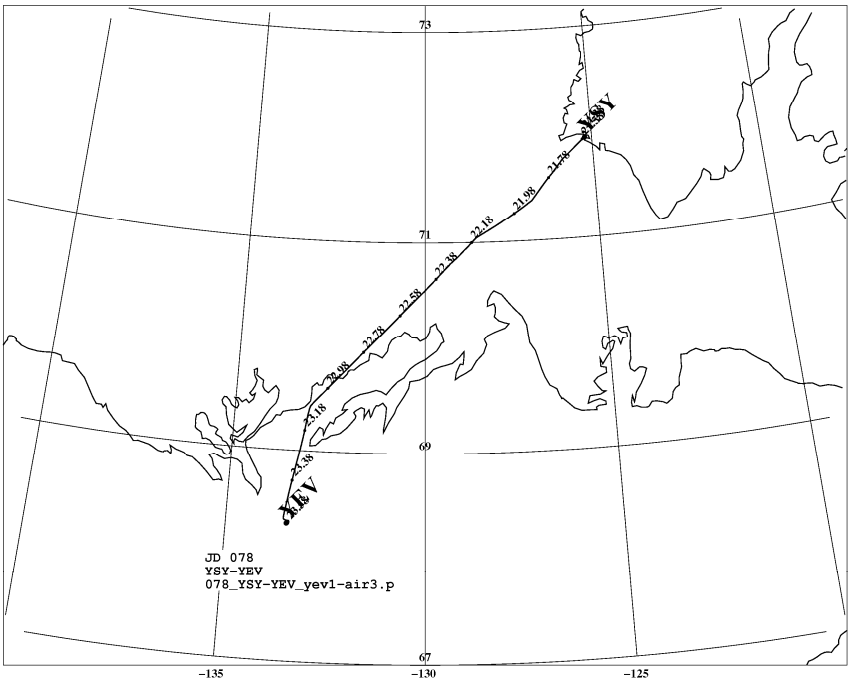
DOY 78 19/3-2014 YRB-YSY-YEV(Inuvik) (calm, -34C, clear sky YRB)

Heating of POF and cabin
1549 Engines on
155730 Scanner sync
Engine trouble POF/cold panel
AIR1/3 no sat, heat cabin, plugs on/off
1625 Start up
1631 Taxi
EGI alt. not good (error in pos – missing minus)
1642 Scanner temp 36, no returns
164430 New scanner file
1652 Half scanner width
1700 Scanner temp 29
->TS0->TS1
170300 New scanner file
Close EGI file, error in align
1443 Scanner almost full swath
AIR1/3 looses signal -> EGI/OXTS out
1753 New OXTS file
175400 New scanner file
No open water en route
1902 Close scanner file, coast line
2020 Landing YSY
Scanner some fog inside
Refuel one drum
YSY-YEV
2130 Taxi
Take off
213400 Scanner sync
213515 New scanner file
EGI ok, AIR1/3 out, cable?
2154 Broken clouds
225630 New scanner file – over land
2300 Stop scanner log
2304 Over Tuktoyaktuk
2335 Landing YEV

ASIRAS LOG

Operator: EN
YRB-YSY
Calibration file: A140319_00_1.ca2
16:40 START File: A140319_00_2_00.dat
17:33 Change to PC1
Event 0 -> 19:01 Reached coastline
Instrument stopped
YSY-YEV
Calibration file: A140319_02_1.ca2
21:36 START File: A140319_02_1_00.dat
22:32 Change to PC2
22:59 Stopped with file A140319_03_2_05.dat
Calibration file: A140319_03_1.ca2





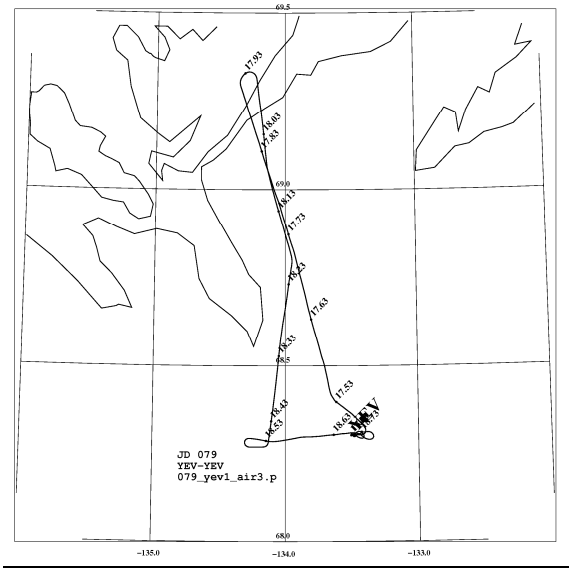
DOY 79 20/3-2014 YEV-YEV (calm, -24C, freezing fog YEV)

Heating of POF and cabin

1605	Start up on 220/110V
164100	Scanner sync + TS1
…	New flight plan VRF->IRF+VRF
1722	Taxi
1726	Take off
	DC-3: Fog, clouds at AW1+2+3
1754	Cancel survey
1847	Landing

ASIRAS LOG

Operator: EN
YEV-YEV
Calibration file: A140320_00_1.ca2
Mission aborted

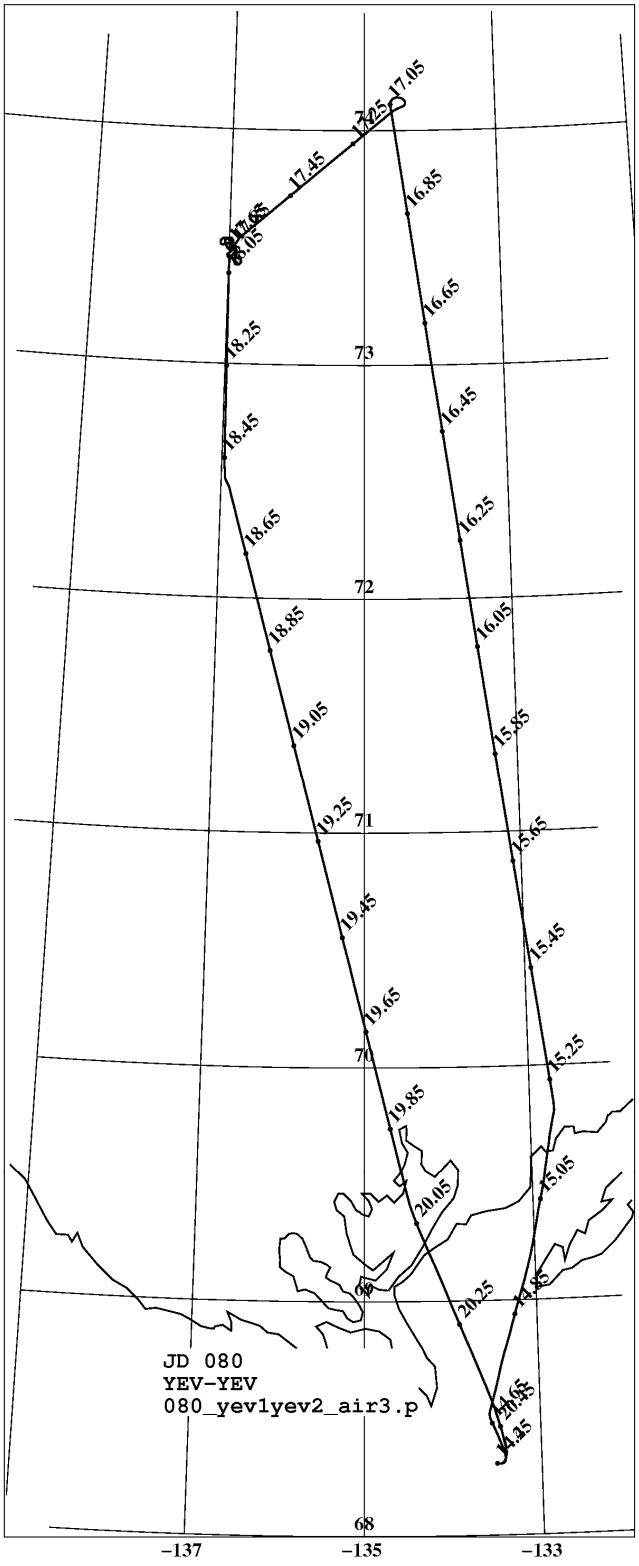


DOY 80 21/3-2014 YEV-CS20942-YEV (calm, -17C, windy at return)

Coincident flight with DC-3 Em bird obs, CS-2 14:56
Heating of POF and cabin
Start up on 220/110V
1421 engine on
142215 Scanner sync + TS1
1429 Taxi
1433 Take off
DC-3take off shortly after
143630 New scanner file, signal ok before – lost signal at file start
Smuk solopgang ☺
1446 DC-3 visual, right side of POF
1505 Decent to 1200 ft
150630 New scanner file, swath almost ok
151130 C1, 140-150 knt, 350m/1200 ft
151400 OXTS log started late!
151430 Lead, then thin ice
152155 Thicker ice
152300 Lead + continue left side
152343 Lead
1539 C2
160000 New scanner file
160420 C3
1616 Low clouds ~30 nm from C3
Scanner file closed
162130 New scanner file
Over-cast but surface visible
163225 C4
170140 C5, tear drop turn
1707 Cross line C4-C5, 105 knt!
171015 New scanner file
173430 New scanner file
1738-9 AW2
1742 CR off
1750 Camp
Strong winds, high clouds and some mist
1756 CR off
1758 Camp
175845 CR almost
1759 Towards AW1
180900 New scanner file
181250 Large lead, partly frozen
1829 AW1, markers maybe to the left
190300 New scanner file
1957 Coast line, end of survey
2001 Scanner file closed
2033 Landing YEV

ASIRAS LOG

Operator: EN
YEV-YEV
14:38 Calibration file: A140321_00_1.ca2
15:06 Calibration file: A140321_01_1.ca2
15:10 ASIRAS started at C1. File A140321_01_1_00.dat
15:39 Event 0 Waypoint C2
16:04 Event 1 Waypoint C3
16:05 Change to PC2
16:32 Event 0 Waypoint C4
17:01 Event 1 Waypoint C5
17:15 Change to PC1. File: A140321_03_1_00.dat
17:50 Camp AW2 overflight. Recorded small SDS: A140321_03_1_00__00.sds
17:56 Camp AW2 overflight. Recorded small SDS: A140321_03_1_00__01.sds
18:28 Event 0 Camp AW1
19:08 Change to PC1. File: A140321_05_1_00.dat
19:58 Stopped
19:58 Calibration file: A140321_02_1.ca2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16.05
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19.65
19.85
15.05
20.05
20.25
73
72
71
70
68
−137
−135
−133
JD 080
YEV-YEV
080_yev1yev2_air3.p

DOY 82 23/3-2014 YEV-AW-YSY-YRB (-11 YEV, clear sky)

Over-flight AW1-AW2-AW3

	Start up on 220/110V, no extra heating
1423	Taxi
1427	Take off
143315	Scanner sync, temp 31
1433	Take off
	Endnu en flot solopgang
	High to first pos, AW1
1606	TS1 (then almost full swath)
160815	New scanner file, 36nm from AW1
161830	New scanner file, after repeate TS1
	Low clouds, no return
162240	AW1 (in clouds, no visual)
1636	Descend to 150 m, still clouds, climb to 400 m
164530	AW2, only ASIRAS
1705	Descend but still clouds at 250 m
170830	AW3 (small patches of scanner data)
1711	Scanner file closed
1716	550-600 m
173815	New scanner file, few returns, 360 m
	Patches of low clouds
184100	New scanner file
1847	Runway over-flight YSY, partly coverage
185145	Runway YSY
1856	Landing
	All off, fuel from drums YSY
2025	Taxi
202530	Scanner sync
2029	Take off
2140	Descend
214145	New scanner file
2154	Coast line
	No open leads for reference
2203	Fog, low clouds
223515	New scanner file, all clear
2259	Patches of low clouds
232600	New scanner file
0026	Landing YRB

ASIRAS LOG

Operator: EN

YEV-YSY

14:37 Calibration file: A140323_00_1.ca2

16:09 Calibration file: A140323_01_1.ca2

Logging on PC1

16:10 Started wilth file: A140323_03_1_00.dat

16:21 Event 0: Waypoint AW1

16:45 Event 1: Waypoint AW2

17:08 Event 2: Waypoint AW3

17:13 Change to PC2

17:13 Started with file: A140323_04_2_00.dat

18:08 Change to PC1

18:09 Started with file: A140323_05_1_00.dat

18:52 Event 0: Second fly-over of Sachs Habour airstripe

18:52 SDS file recorded: A140323_05_00__00.sds

18:53 Calibration file: A140323_02_1.ca2

YSY-YRB

21:53 calibration

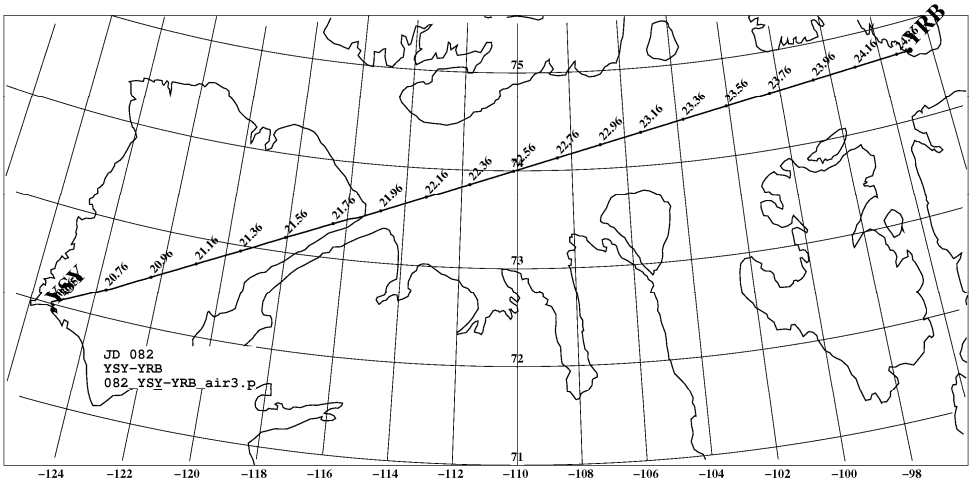
21:55 start rec

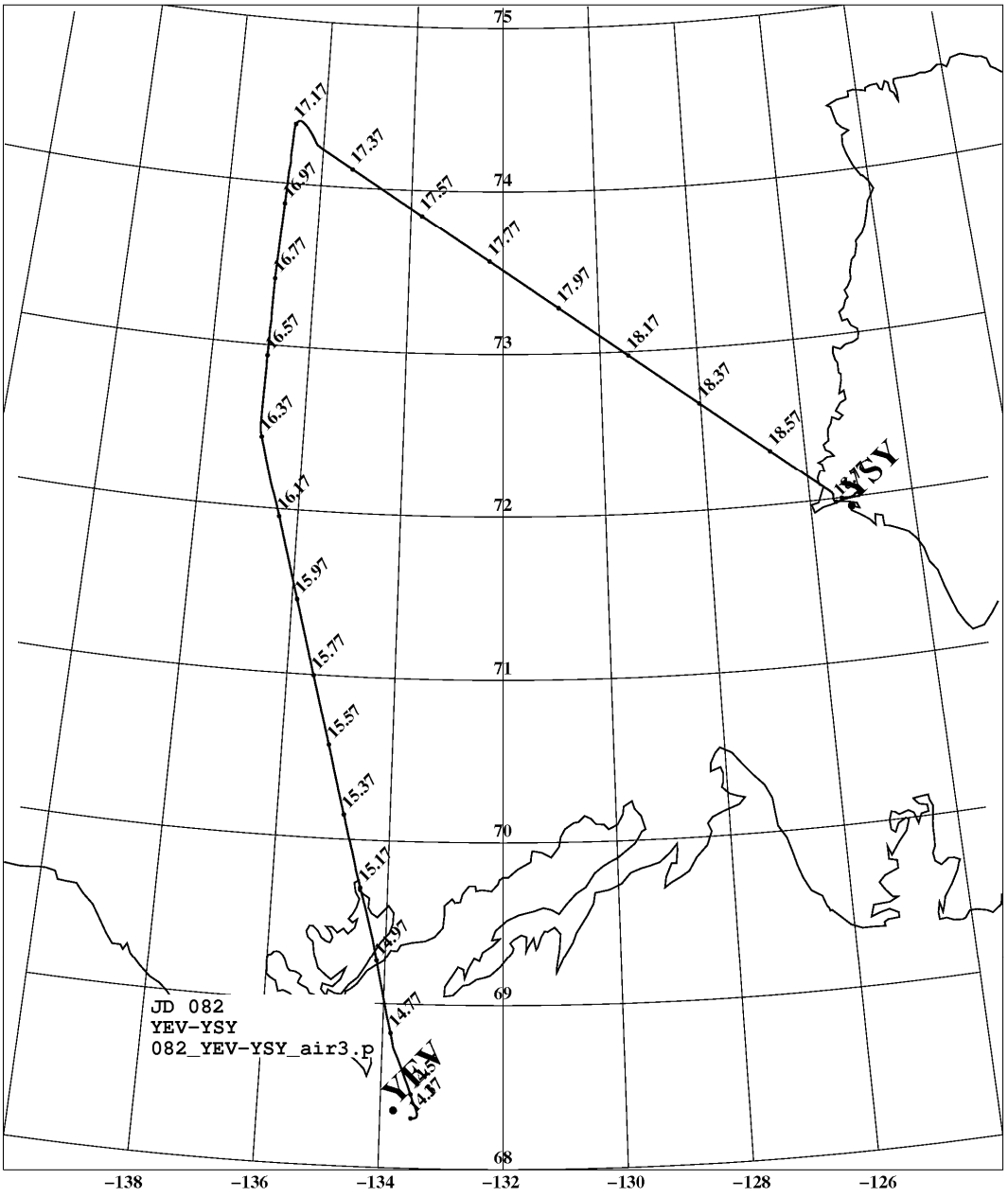
22.24 new file, recording stopped

22:53 stop, start pc2

23:53 stop, start pc1

00:19 stop, calibration

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15.37
15.17
14.97
14.77
14.57
14.37
YSY
YEV
JD 082
YEV-YSY
082_YEV-YSY_air3.p

DOY 84 25/3-2014 YRB-C-EA-EB-YEU-YLT (-25 YRB)

Over-flight CS 21006 EA-EB

	Start up aircraft power
	Diff start, forgot to turn on the inverter
1314	Taxi
1321	Take off
132530	Scanner sync, temp 48, TS1
132730	New scanner file over land, ½ swath
134340	Sea ice, sound between island (YRB) and Devon
140550	Coast line
142000	New scanner file
142230	C1, low clouds, no return
1440	Off track due to island with unknown height
	(Island not incl in EMAP coastline)
1450	Scanner file closed
145745	New scanner file, descend
145845	C2, better visibility
1509	Coast line, climb
1533	Scanner file closed
	Climb and turn to get above mountains and clouds
1556	Deviate line towards EA-EB
160830	New scanner file
1615	EA

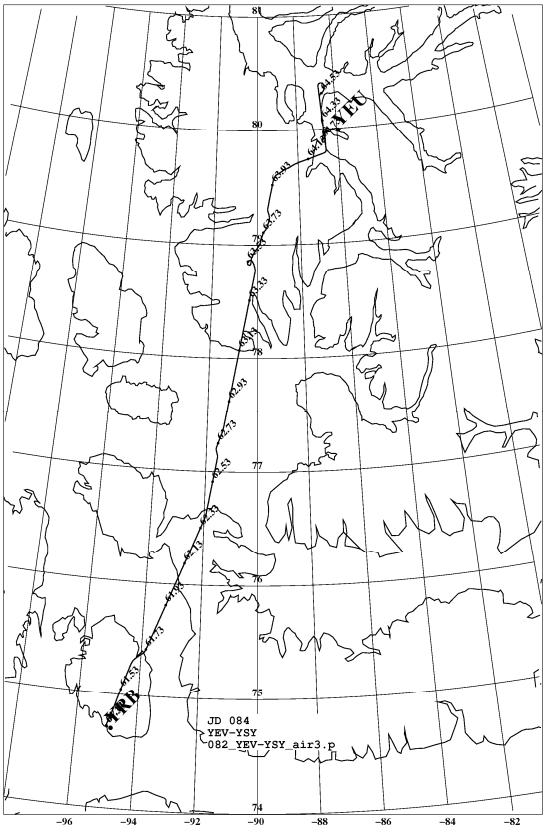
Operator: RF

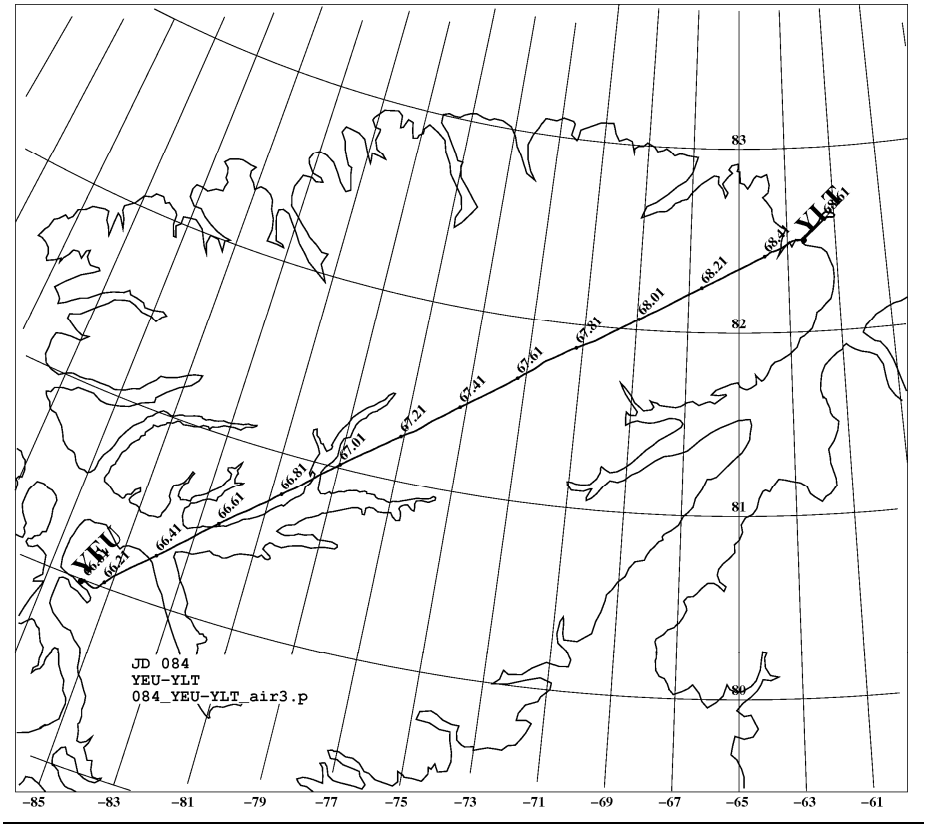
	EB – P-3 coincident
1633	Same line EB-EA
164120	EA 2nd time
164515	X line EA-EB, P-3 overhead
1650	Landing Eureka
1807	Take off YEU
	No survey, late for opening in YLT
20??	Landing YLT

ASIRAS LOG

1315	start taxi
1319	take off
1324	calibration
1342	record pc1, sea ice north of resolute
1404	turbulence
1425	over sea ice, cryosat track
1438	stop rec, clouds/fog, climb
1459	start rec, pc2
1537	stop rec, high altitude
1549	record pc1
1609	start rec, Eureka sea ice line
1641	stop, calibration
1650	on ground Eureaka

No Asiras on leg to Alert





DOY 85 26/3-2014 YLT-CS-CS-YLT (-25 YLT)

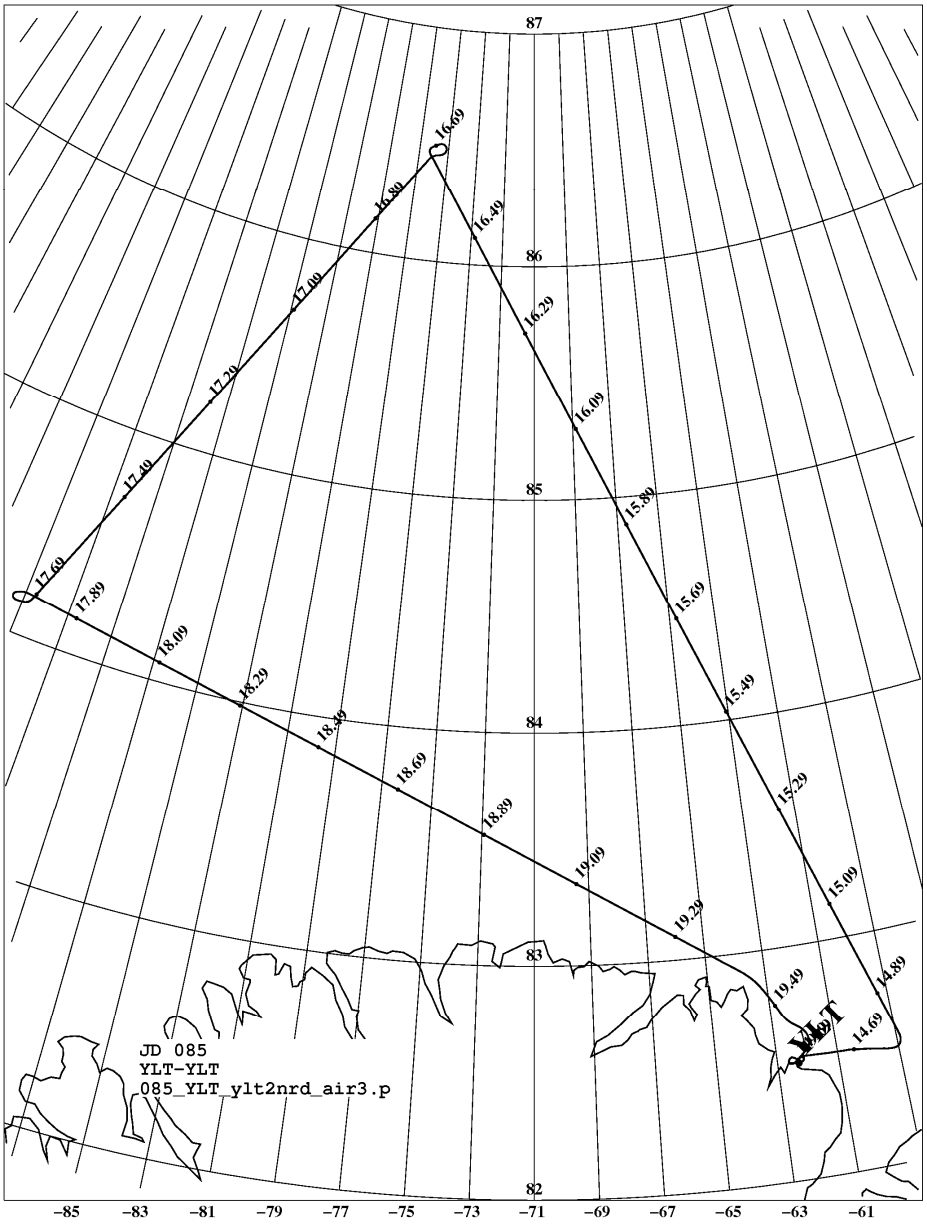
Over-flight CS 21011 and 21021
Coincidentwith DC-3

	Start up on 220V
1359	Taxi to fuel
140645	Scanner sync, temp 51!, TS1
143150	Taxi
143315	New scanner file
1435	Take off
	Temp 51, fan off, signal lost
144600	New scanner file
144750	C1, 1200 ft
1453	½ swath
150910	C2 (DC-3 at C3), ¾ swath
152740	New scanner file, full swath, temp 32
	C4, just next to DC-3
154820	Above DC-3
160710	C5
1610	Some fog on/off
1623	C6
	High ridges/deformed ice, no leads
	Wind from north past days
163000	New scanner file
	Fog/low clouds
1638	Descend to 1000 ft, better signal
163830	C7, right turn to C8
	C8, few leads
165725	Large refrozen lead
165850	C9
170810	C10
1723	C11, clear conditions
173100	New scanner file
174110	C12, right turn (tear drop)
174655	C12
181210	84 1.54, -84 30.0 DC-3 start line here
182500	New scanner file
192425	C13
193100	New scanner file
1936	Runway
193915	X building (Spinnaker)
1942	Landing YLT

ASIRAS LOG

Alert sea ice flight #1
Operator: RF

1430	start taxi
1438	calibration
1445	start rec
1550	overflight dc3
1650	stop, reboot pc1, pc1 non-responsive
	no echo data on screen
1707	reboot all computers and ASIRAS
1715	start record, pc2
1815	start record, pc1
1917 -	pc2
1931 -	pc1, runway overflight
1940	on ground


87
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14.89
14.69
YLT
JD 085
YLT-YLT
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−85
−83
−81
−79
−77
−75
−73
−71
−69
−67
−65
−63
−61

DOY 87 28/3-2014 YLT-CS-Petermann-YLT (-21 YLT)

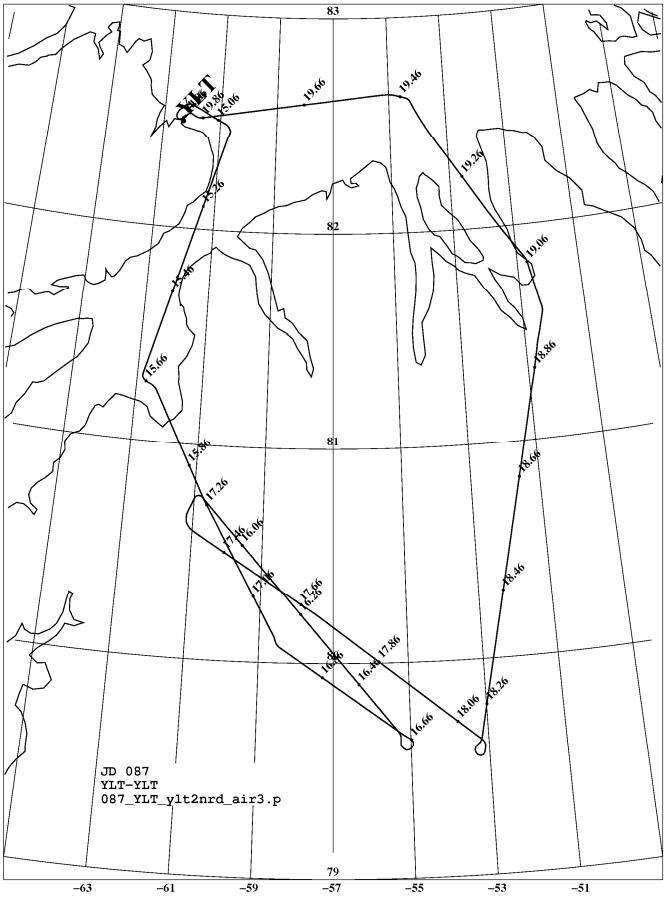
Over-flight CS 21034 in Nares Strait
DC-3 on ground, EM bird problem

1448	Taxi, change WP
144845	Scanner sync, TS1
1455	Take off
	Scanner ok at take off, almost off after
	Recover faster than prev
150630	C20, scanner swath ½
151150	Close to coast line, Ellesmere Island
	¾ swath
1530	Scanner swath almost full
153820	C18
153915	New scanner file
154040	A5, ~200 m off track
155530	A4, new crevasse on left side
162445	New scanner file
163530	A3, turn
164110	A3
1657	G4, left side blue ice, round pattern
172615	New scanner file
1742	G2
180640	C30, turn right, tear drop
181140	X over line ~C30
182115	New scanner file
182510	C31
183830	C32
1846	Ice margin
	Break line, through fiord (Axel Heiberg)
191345	New scanner file
1927	turn to follow rest of line C34-YLT
1955	Landing YLT

ASIRAS LOG

Operator: RF

1457	take off
1458	calib
1459	start rec, pc1
1605	start rec, pc2
1730	start rec, pc2
1808	start rec, pc1
1912	start rec, pc2



DOY 88, 29/3-2014 YLT-CAMP-NRD

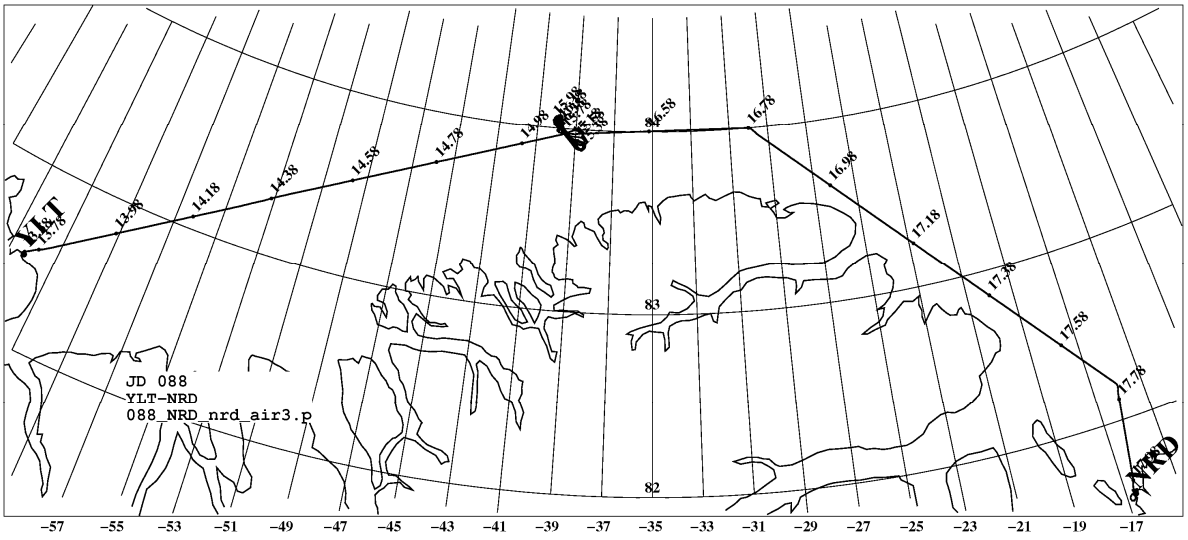
Over-flight of main camp
Coordinated with DC-3 EM bird

	Start up on 220V
125400	Scanner sync, temp 37, TS1
1338	Engines on
1342	Taxi
1344	Take off
134500	New scanner file
	Swath almost gone after take off
	Slowly improving
1401	Scanner swath ½
1415	DC-3 left side
1421	Coordinate update of YLT and C0 to align aircrafts
145600	New scanner file, 9 min to camp
150115	Lead then camp
151140	101-102, time of line start
151815	202-201
152515	301-302
153215	402-401
153940	501-502, center line
154025	CR?
154625	602-601
155335	701-702
160025	802-801
160740	901-902, ~200 m drift drift during survey
161000	New scanner file (1 sec late start)
161400	Line with orange markers
1621	Line with orange markers
1624	Depart camp area
1631	Open leads
1647	E2
170030	New scanner file
1744	E3
1800	Runway NRD
1803	Building
1806	Landing NRD

ASIRAS LOG

Alert-Nord via ice camp
Operator: RF

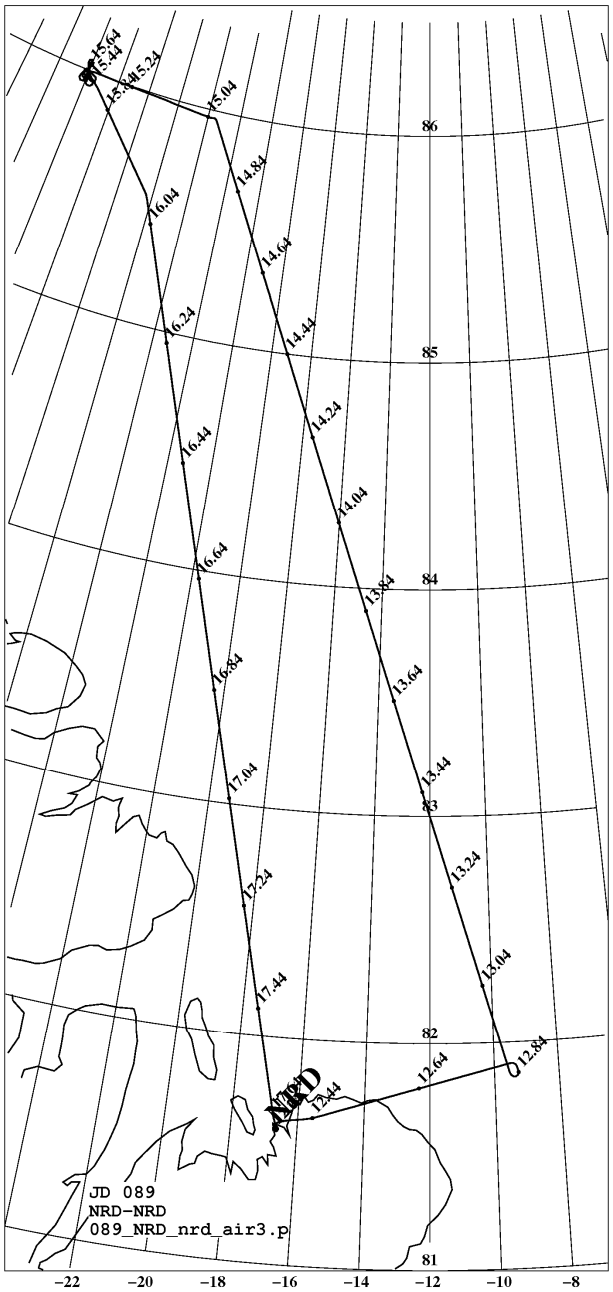
1342	take off
1347	start rec pc1
1502	start rec pc2
1511	camp line 1
1529	camp line 4
1626	start pc1
1706	start pc2



DOY 89 30/3-2014 NRD-CS-camp2-F-NRD

Coincident with DC-3, DC-3 later start

	Start up on 220V
120007	Scanner sync, temp 8, TS1
120900	New scanner file
	Wait for DC-3, diff start of engines
122100	New scanner file
1220	Take off
	Full swath!
1232?	DC-3 take off
1248	L1, tear drop turn right
1250	open lead, left side
1251	large open lead
130830	L2
131500	New scanner file
132455	L3
134200	L4
135940	L5
140850	Very large area of new ice
141500	New scanner file
141810	L6
143730	L7
144050	Large open lead
145650	L8
150050	L9, turn towards camp 2
	Pos update 86N 34 W within 2 miles
150900	New scanner file
1530	~over camp 2 area
1547	~leave camp area
155145	New scanner file
155920	F2
164000	New scanner file
1741	Landing NRD



ASIRAS LOG

Operator: EN

12:24	Calibration file: A140330_01_1.ca2
12:26	PC1 logging file: A140330_00_1_00.dat to _11.dat
12:48	Event 0 on PC1. Turn at L1.
13:08	Event 1 on PC1. Waypoint L2.
13:24	Event 2 on PC1. Waypoint L3.
13:26	PC2 logging file: A140330_01_2_00.dat to _10.dat
13:59	Event 0 on PC2. Waypoint L5.
14:17	Event 1 on PC2. Waypoint L6.
14:18	PC1 logging file: A140330_02_1_00.dat to _18.dat
14:56	Event 0 on PC1. Waypoint L8.
15:00	Event 1 on PC1. Waypoint L9.
17:28-17:43	Line over-flights OF Ice-camp North. At ~86N 34W
15:50	PC2 logging file: A140330_03_2_00.dat to _10.dat
15:59	Event 0 on PC2. Waypoint F2.
16:42	PC1 logging file: A140330_04_1_00.dat to _.dat

DOY 90 31/3-2014 NRD-CS-CS-NRD

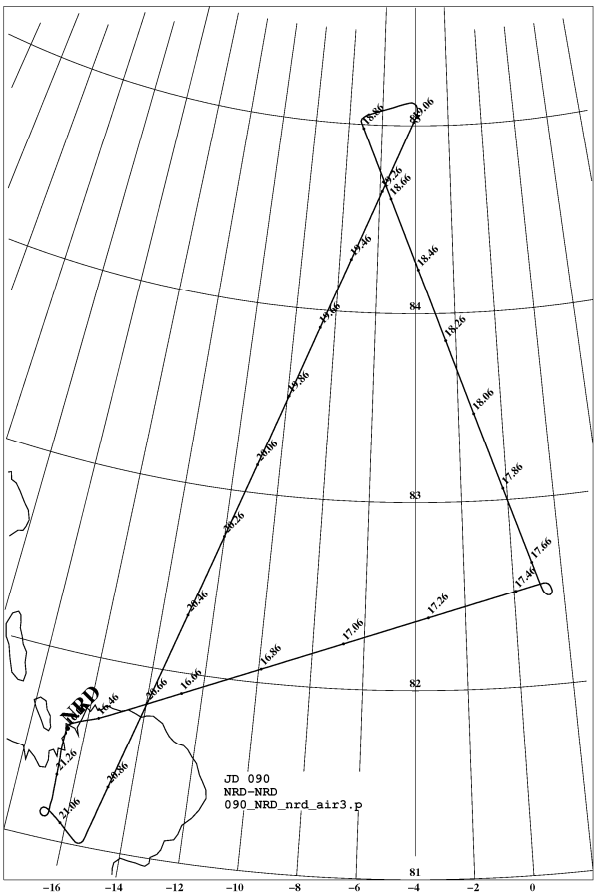
CS orbit 21090 at 19:48, and 21081

155400 Scanner sync, temp 3, TS1
GoPro not active, no time to fix
161040 Taxi
1615 Wait for DC-3, diff start of EM bird
161800 New scanner file
1620 DC-3Take off
1622 Take off
171500 New scanner file
173030 M1, right turn – tear drop
173530 M1, on line
173715 large refrozen lead
181020 M3
181100 New scanner file (1 sec late)
182755 M4
1852 M5, DC-3 left side
190150 N1, DC-3 just ahead
Speed reduced to 120 knt, few miles behind DC-3
190415 New scanner file
191050 N2
1926 Very large area of new ice
192850 N3
194710 N4
1948 CS!
200510 N5
200545 New scanner file
202210 N6
202230 Cruise speed ~155 knt
2030 over DC-3
203640 N7
203745 New scanner file
Close to coast
2058 Break line – just before N8
<2103 AIR1 mem full
2106 P1(drained lake under ice)
Left turn over P1
210950 P1
2123 Landing

ASIRAS LOG

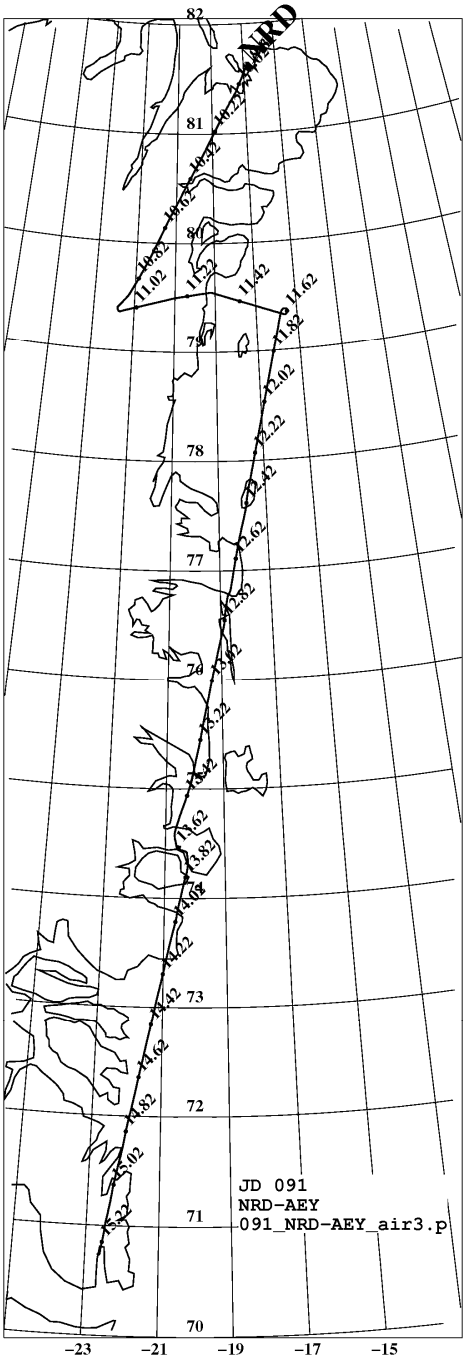
Operator: RF

1622 t/o
1625 calib, pc1 (no data rec)
1731 start rec, pc1
1850 start rec, pc2
1949 cs2 overhead
1959 system hangs, reboot prog., start rec pc1
2112 stop rec, calib



DOY 91 1/4-2014 NRD-79fj-TOB-CNP-AEY

093530	Scanner sync, temp 7, TS1
	GoPro not active, no time to fix
0949	Taxi
0951	Take off
094900	New scanner file
0955	File closed
105600	New scanner file
105740	G9, elev ~1000m, crevasses
111000	G8
1117	Glacier front
113430	TOB – then left turn to X
113930	TOB from north
114200	New scanner file
1218	End of fast ice, island(Ils de France)
	Climb to transit, continue direct to CNP
132430	New scanner file
1355	Overflight Zackenberg runway
135030	Scanner file closed
1517	Landing CNP
1556	Take off CNP, EGI not aligned but on
	AIR3, EGI on else all off
1810	Landing AEY



ASIRAS LOG

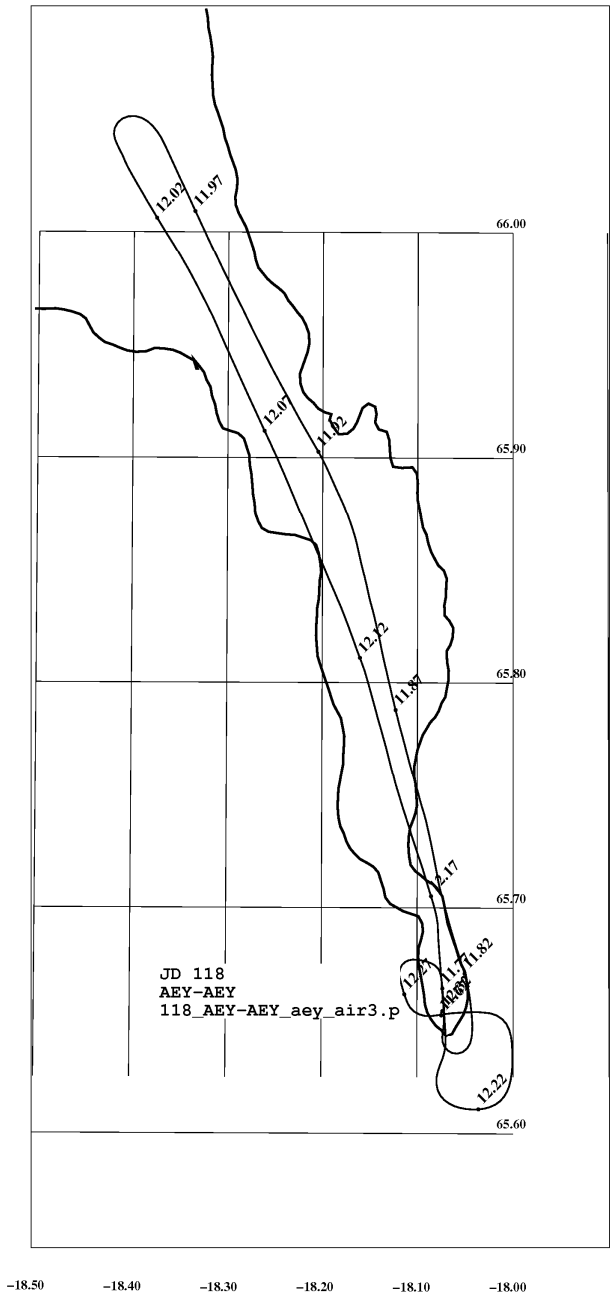
Operator: EN

10:52	Calibration file: A140401_00_1.ca2
10:56	Started logging on PC2: A140401_00_2_00.dat to _08.dat
11:16	Event 0 on PC2 - Waypoint G7.
11:34	Event 1 on PC2 - Waypoint TOB.
11:37	Started logging on PC1: A140401_00_1_00.dat to _08.dat
12:19	Calibration file: A140401_01_1.ca2

DOY 118 28/4-2014 AEY-test-AEY-CNP-DMH

Change antenna cable rear, splitter to ant.

	Scanner sync
114200	New scanner file
1143	Taxi
1148	Take off
1159	Turn end of fjord line, towards runway
1211	Runway, 1000 ft
1216	Building
1217?	Landing AEY
1314	Taxi
	EGI not aligned, NAV during alignment
1317	Take off
132330	Scanner sync, tem 33
1440	Start descend for sea ice
144600	New scanner file
1448	Broken sea ice floes from 68N50 and northwards
1507	Climb above clouds
1508	Scanner file closed
152300	New scanner file, ~570m altitude
1541	Landing CNP
	Align EGI
1600	Taxi
1600	Take off
160616	Scanner sync, temp 33
173530	New scanner file
174130	B1
183420	B2
184940	B3, end of survey
~1835	EGI PC down, rebooted ~1855
1915	Landing DMH



ASIRAS LOG

Operator: EN/SBS

1148	Test AEY
1440	Test over sea ice


77
75
73
-20
DMH
CNP
JD 118
CNP-DMH
118_CNP-DMH_air3.p

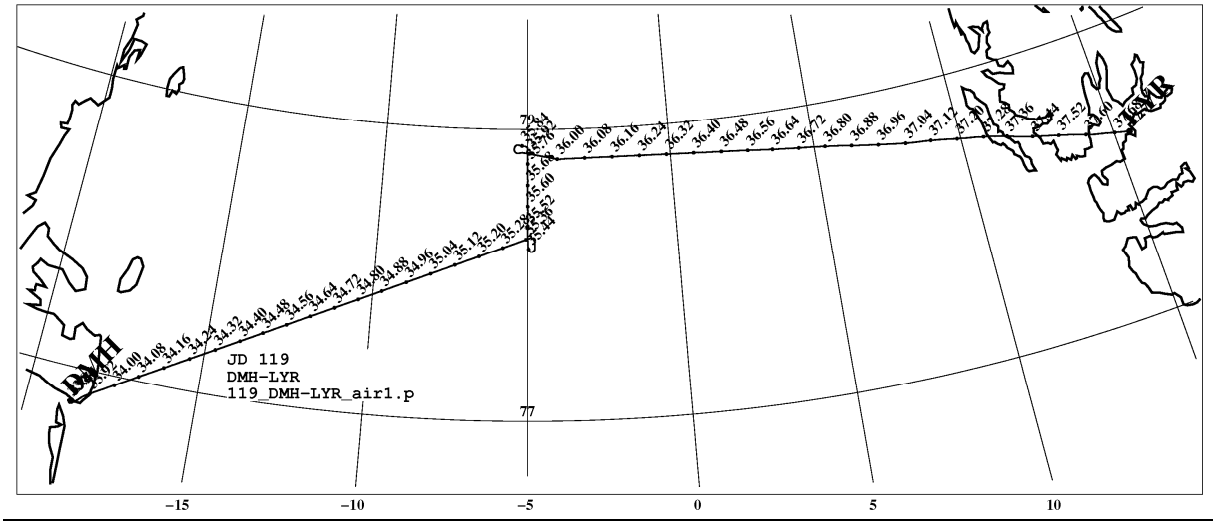
DOY 119 29/4-2014 DMH-ULS-LYR

Start up issues with rack PC
092515 Scanner sync
0944 Taxi
0949 Take off
095200 New scanner file
1022 Some clouds
1026 Climb above clouds
1027 Close scanner file
102930 New scanner file
1049 Close scanner file, clouds
105200 New scanner file
1054 Descend to 300m, end of clouds
111900 New scanner file
1128 F14
1147 F13, left turn (tear drop)
1154 F13
1159 F12
121400 New scanner file
1232 Close scanner file
1344 Landing LYR

ASIRAS LOG

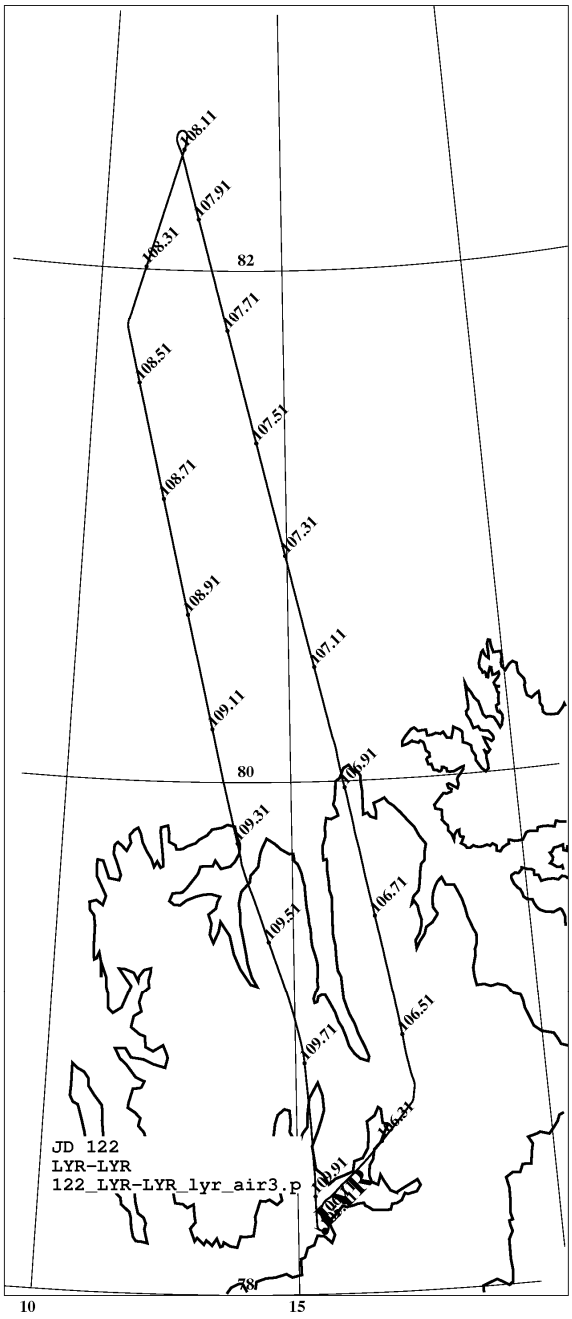
Operator: SBS

0943 uEye DTU, started, time on pc was 1143.
0944 GoPro DTU started
0952 ASIRAS PC1 calibration
0954 ASIRAS PC2 started
1045 ASIRAS PC2 stopped
1045 ASIRAS PC1 started
1118 uEye DTU Changed parameters
1150 ASIRAS PC1 stopped
1150 ASIRAS PC2 started
1232 ASIRAS PC2 stopped
1233 ASIRAS PC1 calibration
1235 uEye DTU stopped, time on pc was 1435.
1235 uEye DTU time on pc changed to UTC.
1236 GoPro DTU stopped



DOY 122 2/5-2014 LYR-SEAICE-LYR

0959	Taxi
1003	Take off Heading for ETON_1 to check conditions at Austfonna
1023	Low clouds over Austfonna, head for CS track – CS2
105645	New scanner file
1058	CS2
110325	CS3
112245	CS4
114200	CS5
1200	CS6, Right turn, tear drop
120650	CS6
120920	New scanner file
1225	L4
124745	L3
131045	L2
131300	New scanner file
1359	Landing



ASIRAS LOG

Operator: SBS

0927	uEye DTU started and stopped
0954	GoPro DTU Started
0954	uEye DTU Started
1015	uEye DTU Changed parameters
102x	uEye DTU Changed parameters
1054	ASIRAS PC1 calibration
1057	ASIRAS PC1 Started
1100	flight level now 300m
1101	uEye DTU Changed parameters
1105	uEye DTU Changed parameters
1110	uEye DTU Changed parameters
1209	ASIRAS PC1 Stopped
1209	ASIRAS PC2 Started
1302	ASIRAS PC2 Stopped
1302	ASIRAS PC1 Started
1319	ASIRAS PC1 Stopped
1320	ASIRAS PC1 Calibration
1322	uEye DTU Stopped
1329	GoPro DTU Stopped

DOY 123, May 03 2014, LYR-AUS-LYR

SMH/LSS, SBS

GPS reference placed in LYR

0820 Taxi
0823 Take off LYR
091215 New scanner file
091730 ETON1
092000 SV2
092214 CR2 (distance 7)
092250 CR3 (distance 6)
092630 SV3
0930 SV4
093430 SV5
0937 SV7
0942 clouds
094900 New scanner file
0952 0408-8. Still clouds
0955 cloud free
095730 0405-6
100320 0405-4
101925 0605-4
102311 CR2 (distance -2)
1025 0605-6
1026 clouds – stop scanner log
1028 climb to higher alt. + break off line due to clouds
103115 New scanner file
1050 e2b
105700 e2a
110220 w1a
1108 w1b
111530 e1b
112150 e1a
112400 New scanner file
1127 w2a
1132 w2b
113900 e3b
1145 e3a
Found problem with the wp's for the w3 line. Decided to fly relative to the wp's for w2.
1150-1157 w3a-w3b
1203 B3_01
120426 B3_02
1209 B3_03
1212 B3_04
121700 New scanner file
1220 B3_14
1223 B3_09
122830 B3_07
1243 ss_s
1249 stop scanner log
1331 landing

JD 123, May 03 2014, LYR-NRD

LSS, SBS

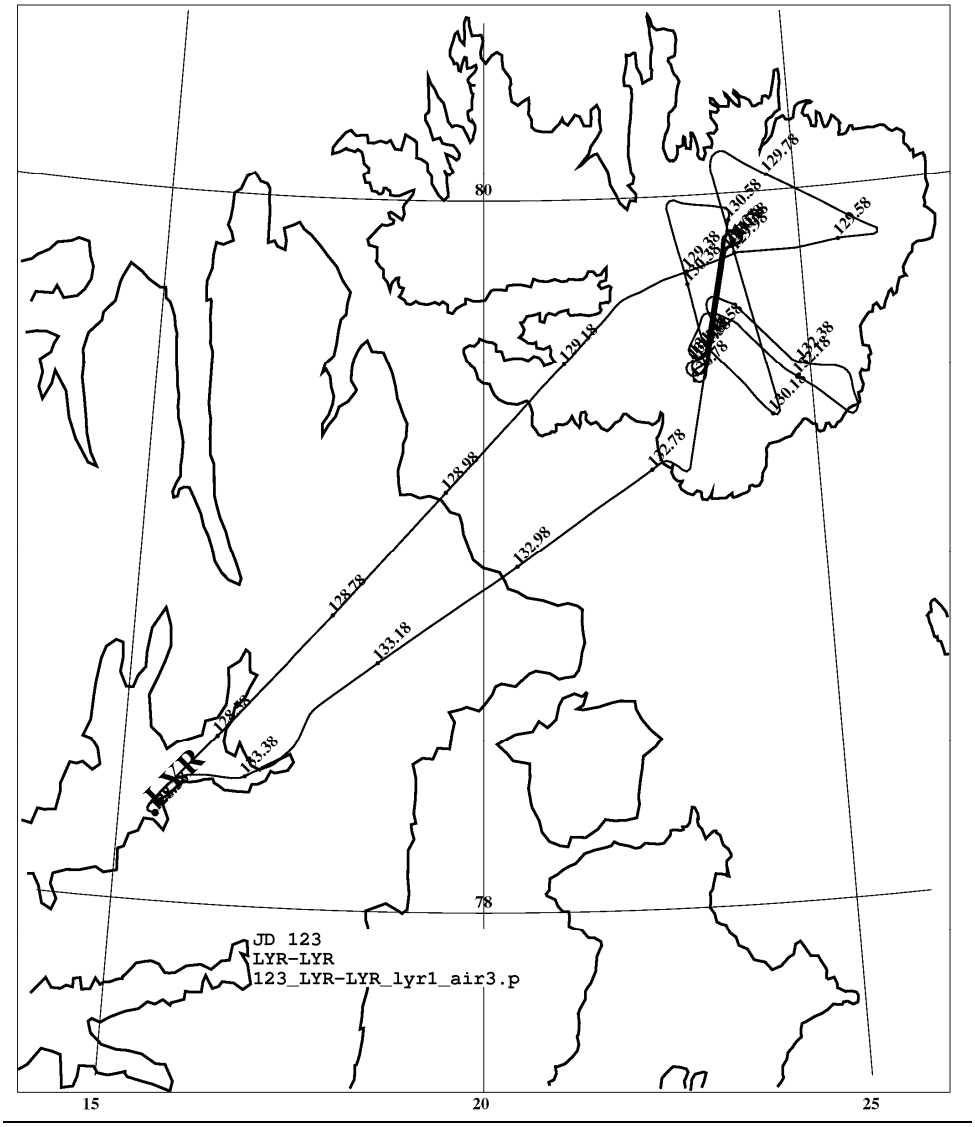
1442 Taxi
1444 Take off
Started measurements on line LYR-KV9
145730 New scanner file
1503 KV9
1506 clouds – climb to higher alt.
1516 scanner stop log
1610 Descend to below clouds (on EN7-EN8 line)
161200 New scanner file
1658 scattered clouds/fog
170115 New scanner file
1718 EN8
1724 clouds – climb to higher alt.
1727 Descend to 1000ft
1729 low clouds
~1740 fly over runway and building for calibration
1746 landing

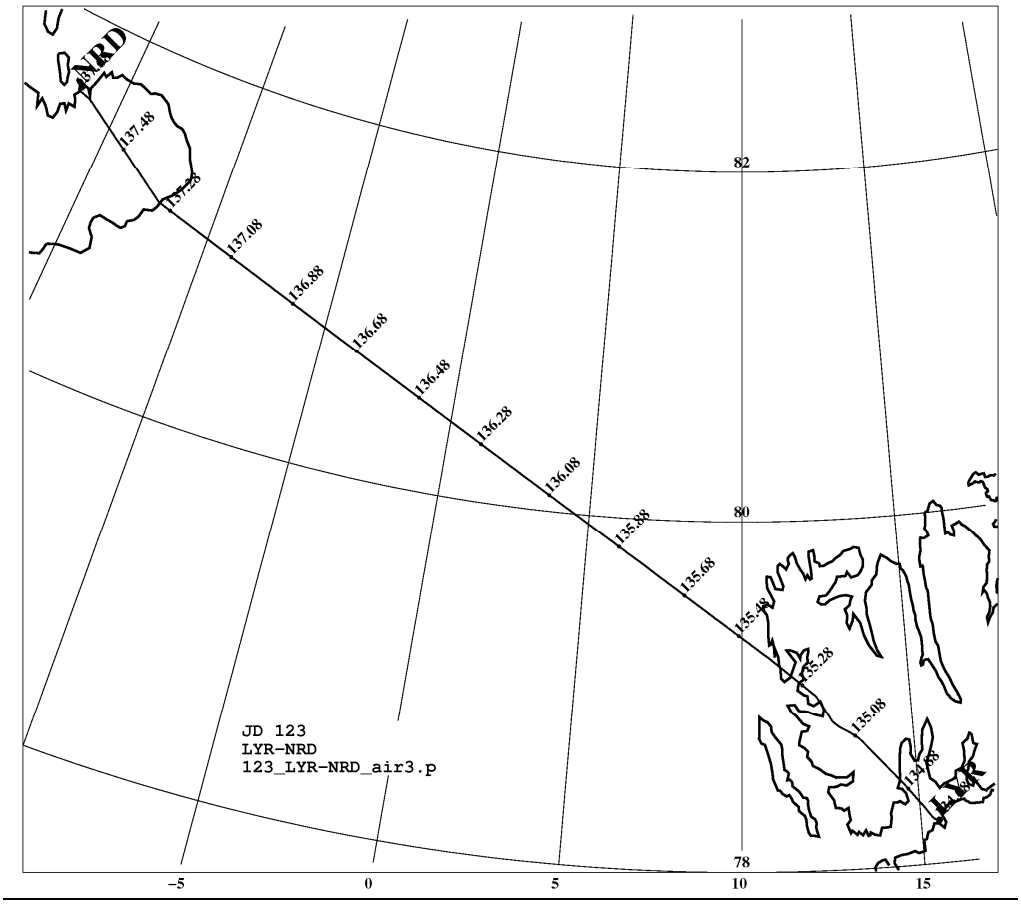
ASIRAS LOG

Instrument: ASIRAS, uEye and GoPro camera.
Operator: SBS
0821 GoPro DTU started
0822 uEye DTU started
0844 uEye DTU Changed parameters
0902 ASIRAS PC1 calibration
0911 ASIRAS PC1 Started
0937 ASIRAS PC1 Event0 at turn of plane
0947 ASIRAS PC1 Stopped
0948 ASIRAS PC2 Started
0948-0952 ASIRAS PC2
Due to cloudy conditions keeping track of the surface was difficult.
1022 ASIRAS PC2
looked like we hit two corner reflectors
1027 Cutting flight path due to cloudy conditions

1057	ASIRAS PC2 Stopped
1057	ASIRAS PC1 Started
1146	ASIRAS PC1 Stopped
1146	ASIRAS PC2 Started
1246	ASIRAS PC2 Stopped
1246	ASIRAS PC1 Calibration
1249	uEye DTU stopped
1250	GoPro DTU stopped
1440	uEye DTU started file name: 123_b_*
1441	GoPro DTU started
1453	ASIRAS PC1 Calibration
1453	ASIRAS PC1 Started

1456	ASIRAS fixed on surface
1527	ASIRAS PC1 Stopped, no ice
1528	ASIRAS PC1 Calibration
1530	uEye DTU stopped
1610	ASIRAS PC1 Calibration
1611	ASIRAS PC2 Started
1618	uEye DTU Started file name: 123_c_*
1700	ASIRAS PC2 Stopped
1700	ASIRAS PC1 Started
1737	ASIRAS PC1 Stopped
1737	ASIRAS PC1 Calibration
1738	uEye DTU Stopped
1747	GoPro DTU Stopped.




NRD
137.48
137.28
137.08
136.88
136.68
136.48
136.28
136.08
135.88
135.68
135.48
135.28
135.08
134.88
LYR
82
80
78
−5
0
5
10
15
JD 123
LYR-NRD
123_LYR-NRD_air3.p

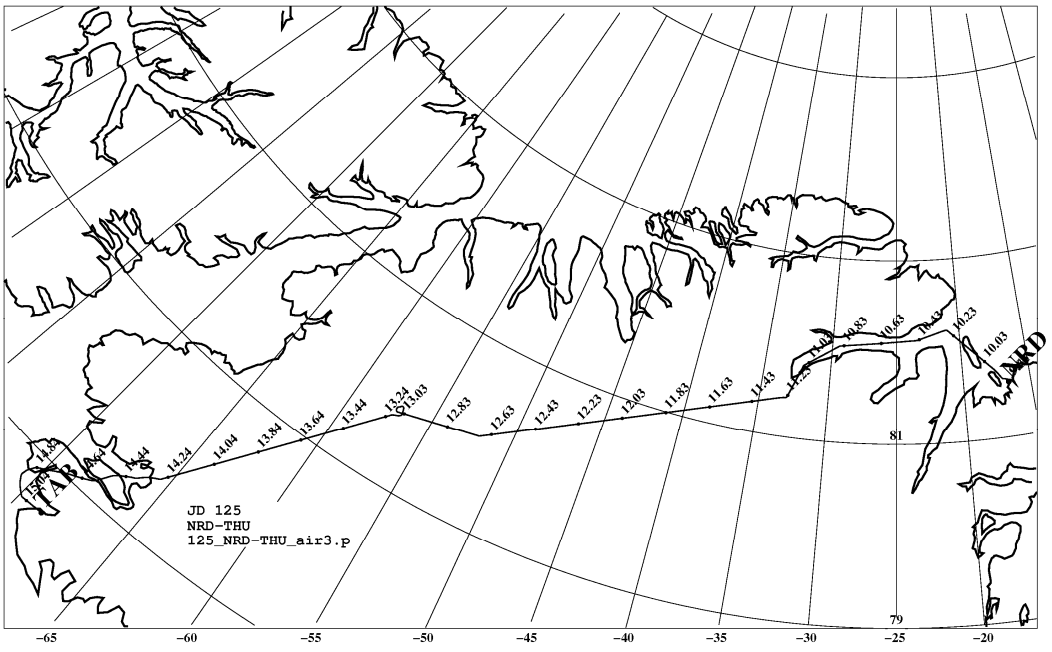
DOY 125, May 05 2014, NRD-THU

LSS, SBS

093415 scanner sync
0948 taxi
0951 take off
095600 new scanner file
1015 H1
1026 H2
1038 H3
1050 H4
1103 H5
1114 H6
111500 new scanner file
121200 new scanner file
We do not have enough fuel to measure also the CR-ICE3-ICE4 track. New plan : P2-THU
1240 P1
1303 P2
Right turn – teardrop, for scanner calibration
131115 new scanner file
140315 new scanner file
1421 scanner stop log
1508 landing TAB

ASIRAS LOG

Operator: SBS
0944 GoPro DTU Started
0949 uEye DTU Started
0957 ASIRAS PC1 Calibration
0958 ASIRAS PC1 Started
1038 uEye DTU Stopped. No more disk space, not sure when the recordings stopped but the images 125_001051-125_001063 is saved as empty files.
1049 uEye DTU restarted on new disk, file names 125_b_*
1054 ASIRAS PC1 Stopped
1055 ASIRAS PC2 Started
1106 uEye DTU Stopped and reloaded new parameters
1107 uEye DTU Started
1107 At the front of the glacier in Independence fjord.
1157 ASIRAS PC2 Stopped
1157 ASIRAS PC1 Started
1255 ASIRAS PC1 Lost track of the surface, but relocated shortly after
1310 ASIRAS PC1 Stopped
1311 ASIRAS PC2 Started
1315 GoPro DTU Stopped, we are now heading directly for TAB
1405 ASIRAS PC2 Stopped
1405 ASIRAS PC1 Started
1417 ASIRAS PC1 flying over land, problems with tracking the surface.
1420 ASIRAS PC1 Stopped
1421 ASIRAS PC1 calibration
1422 uEye DTU Stopped



DOY 126, May 06 2014, THU-DEVON-THU

LSS, SBS

Corner reflector coorinates from David Burgess:

75 20.287 N 82 40.68 W

1227 taxi

1232 take off

1404 May3_2012_10

140440 New scanner file

1409 May3_2012_8

1415 May3_2012_6

1421 May3_2012_3

1423 turbulence

1428 May3_2012_1

1435 Apr22_2012_17

1440 turbulence

1443 Apr22_2012_13

1550 clouds

1454 Apr22_2012_7

1501 Apr22_2012_3

150200 new scanner file

1505 623_1

1509 623_4

1513 CR_SUMMIT (distance: -2)

1516 623_15

Turbulence – shorten the line

153800 new scanner file

1538- low clouds – do data on the lines 450_9 - 450_8 - 450_7

1547 CR_SUMMIT (distance = 7)

Unfortunately no scanner data during the overflight of this CR due to clouds

Due to clouds we have to skip the Belcher glacier, head for THU

1557 Stop scanner log

1718 Landing THU

ASIRAS LOG

Operator: SBS

1227 GoPro DTU Problems with connection to the computer during the night resulted in the GoPro Cam was not used on this flight

1227 uEye DTU Started

1243 uEye DTU Stopped and changed parameters

1244 uEye DTU Started

1245 ASIRAS PC1 Calibration

1403 uEye DTU Stopped, changed parameters and started

1403 ASIRAS PC1 Calibration

1405 ASIRAS PC1 Started

1406 ASIRAS PC1 Fixed on surface

1417 uEye DTU Stopped, changed parameters and, started

1422 A lot of turbulence

1431 ASIRAS PC1Lost track of surface

1435 ASIRAS PC1 relocated the surface

1438 A little inflight turbulence

1459 ASIRAS PC1 Lost track of surface due to local topography

1506 ASIRAS PC1 relocated surface

1512 ASIRAS PC1 Event 0, at corner reflector

1520 ASIRAS PC1 Stopped

1521 ASIRAS PC2 Started during turn, lost track of surface echo

1528 ASIRAS PC2 relocated surface

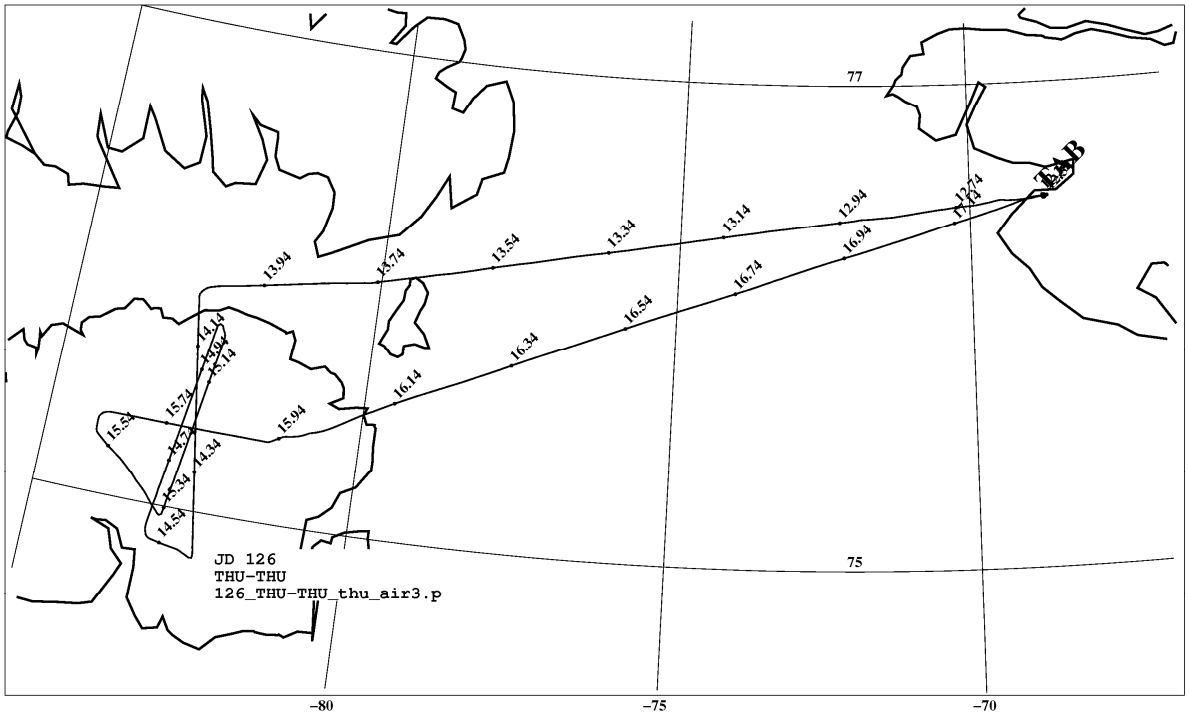
1543 uEye DTU Stopped, changed parameters and started

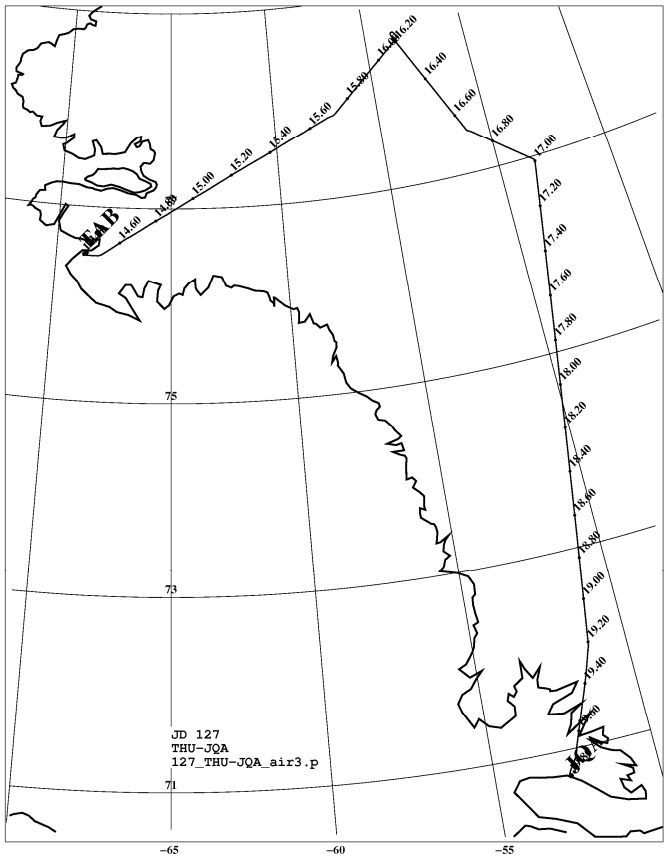
1545 ASIRAS PC2 Corner reflector, no event mark due to the instrument running on PC2

1554 ASIRAS PC2 Stopped

1555 ASIRAS PC1 Calibration

1718 uEye DTU Stopped after landing in TAB


77
75
−80
−75
−70
13.94
13.74
13.54
13.34
13.14
12.94
12.74
16.94
16.74
16.54
16.34
16.14
15.94
15.74
15.54
14.14
15.14
14.34
14.54
JD 126
THU-THU
126_THU-THU_thu_air3.p


75
73
71
−65
−60
−55
16.20
16.40
16.60
16.80
17.00
17.20
17.40
17.60
17.80
18.00
18.20
18.40
18.60
18.80
19.00
19.20
19.40
15.80
15.60
15.40
15.20
15.00
14.60
JD 127
THU-JQA
127_THU-JQA_air3.p

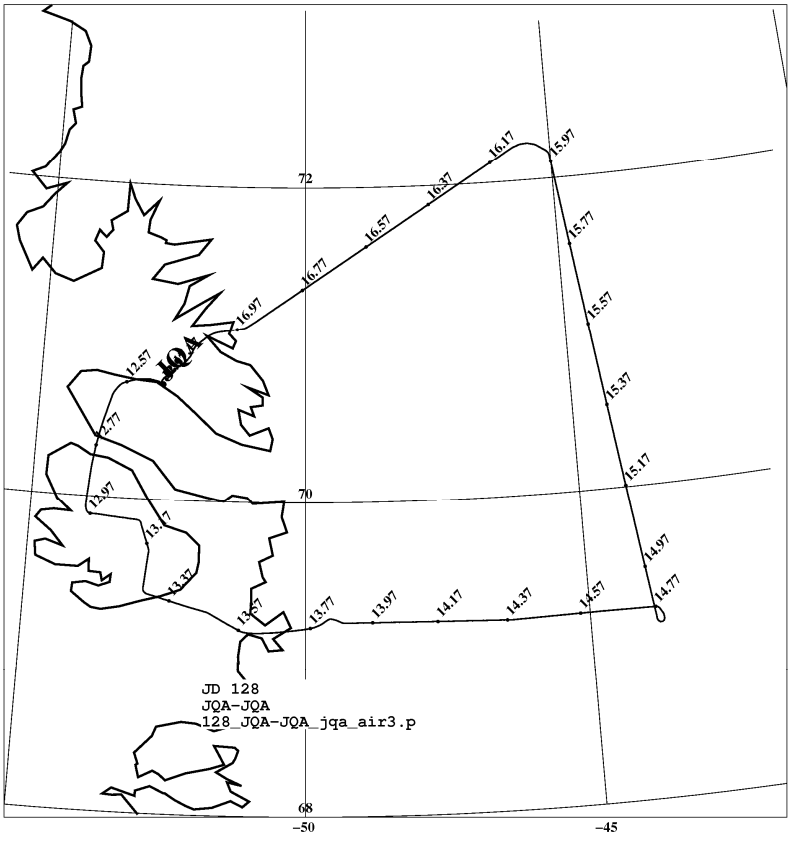
DOY 127, 7/5-2014, TAB-ICE4-ICE3-NEEM-CS21627-JQA

1416	taxi
1420	take off
150530	new scanner file
154145	new scanner file
1543	ICE4
1605	ICE3
	Left turn, tear drop
1611	ICE3
162900	new scanner file
1640	NEEM
165530	new scanner file
1659	CS1
1722	CS2
1746	CS3
175245	new scanner file
1810	CS4
1838	CS5
1912	CS7
1947	landing JQA

ASIRAS LOG

Operator: SBS

1412	GoPro DTU No ground power night resulted in the GoPro Cam was not used on this flight
1412	uEye DTU Started
1417	uEye DTU Changed parameters
1426	uEye DTU Changed parameters
1500	ASIRAS PC1 Calibration
1502	ASIRAS PC1 Started
1530	Observed a camp on the ice sheet
1558	ASIRAS PC1 Stopped
1559	ASIRAS PC2 Started
1605	At the turn
1638	At the NEEM site
1658	ASIRAS PC2 Stopped
1659	ASIRAS PC1 Started
1659	Started to fly the CryoSat track
1757	ASIRAS PC1 Stopped
1757	ASIRAS PC2 Started
1855	ASIRAS PC2 Stopped
1855	ASIRAS PC1 Started
1913	ASIRAS PC1 Stopped
1914	ASIRAS PC1 Calibration
1948	uEye DTU Stopped



DOY 128, 8/5-2014, JQA-disko-CS21706-JQA

LSS, SBS
Reference GPS in JQA (Qaarsut)

1224 taxi
1226 take off JQA
130045 new scanner file
1302 G4
turbulence
1305 G6
1310 G7
131630 G8
1318 stop scanner log
133400 new scanner file
141950 new scanner file
1422 J1
1430 J2
1437 J3
1443 J4
1446 crosses CS21706
Right turn, teardrop
1451 crossing line
1501 830
1515 835
151630 new scanner file
1528 840
1534 ground fog/low clouds-but still scanner data
1542 845
1556 850
1557 low clouds – no scanner data
1558 left turn – depart from line 850-855 due to low clouds
1600 stop scanner log
160915 new scanner log
1656 stop scanner log
1714 landing JQA

ASIRAS LOG

Operator: SBS

1220 GoPro DTU Started
1220 uEye DTU Started
1231 ASIRAS PC1 Calibration
1253 ASIRAS PC1 Calibration
1258 ASIRAS PC1 Started
1301 ASIRAS PC1 Surface echo located
1317 Done with the flight of Disko island, lost surface echo on ASIRAS
1319 ASIRAS PC1 Relocated surface echo of the icefjord, at 840 meters
1347 At the front of jakobshavn Isbræ
1355 uEye DTU Stopped and started
1357 ASIRAS PC1 Stopped
1357 ASIRAS PC2 Started
1420 Observed camp on the ice
1444 Turning onto the cryostat track
1447 ASIRAS PC2 Stopped
1447 ASIRAS PC1 Started
1547 ASIRAS PC1 Stopped
1547 ASIRAS PC2 Started
1557 Turned away from the cryostat track due to low clouds.
Heading for the coast
1557 uEye DTU Formation of ice on the lenses
1631 ASIRAS PC2 Stopped
1631 ASIRAS PC1 Started
1655 ASIRAS PC1 Stopped
1656 ASIRAS PC1 Calibration
1714 uEye DTU Stopped
1715 GoPro DTU Stopped

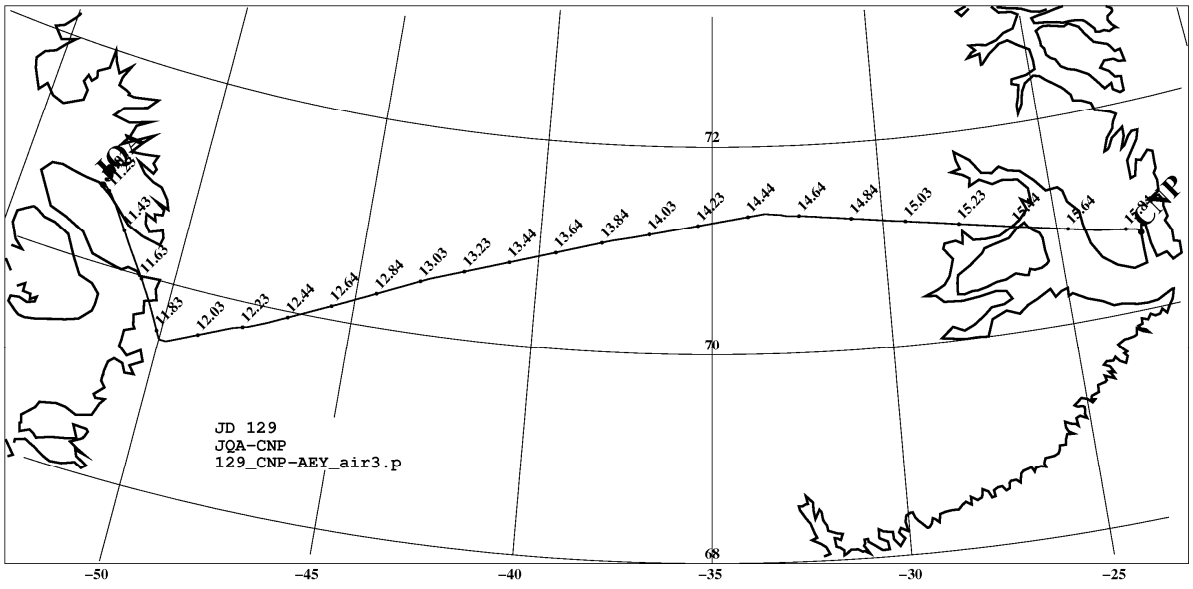
DOY 129, 9/5-2014, JQA-EGIG-CNP-AEY

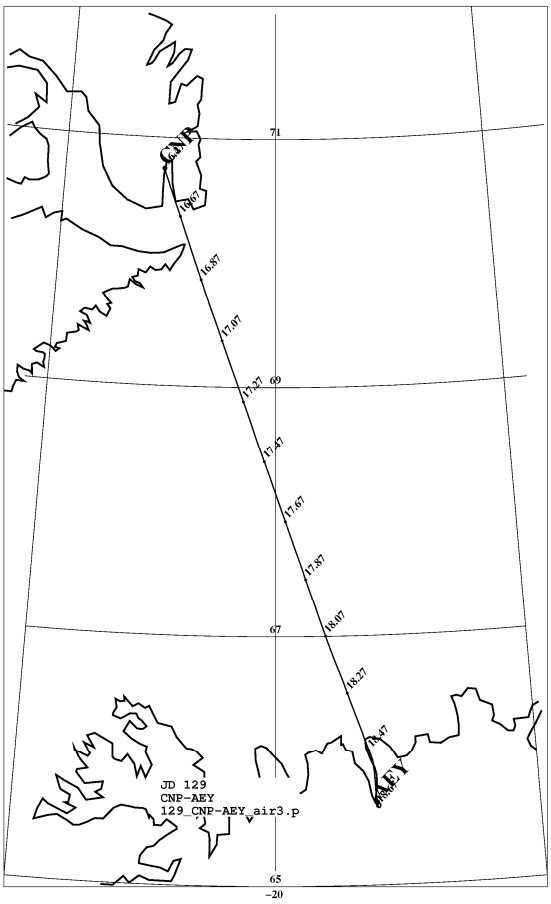
104715	Scanner snyc
1104	taxi
1108	take off JQA
1152	on line JAV-T1
115240	new scanner file
1211	T1
1215	T3
1220	T5
1240	T12
124645	new scanner file
1304	T21
134030	new scanner file
1352	T41
1357	EG5
1429	EG6
143130	new scanner file
	Just autopilot
1459	Stop scanner log
1554	landing CNP
1625	Taxi
1627	Take off
	Transit to AEY
183030	New scanner file
1838-43	Crossing over the building in AEY
1844	Landing AEY

ASIRAS LOG

Operator: SBS

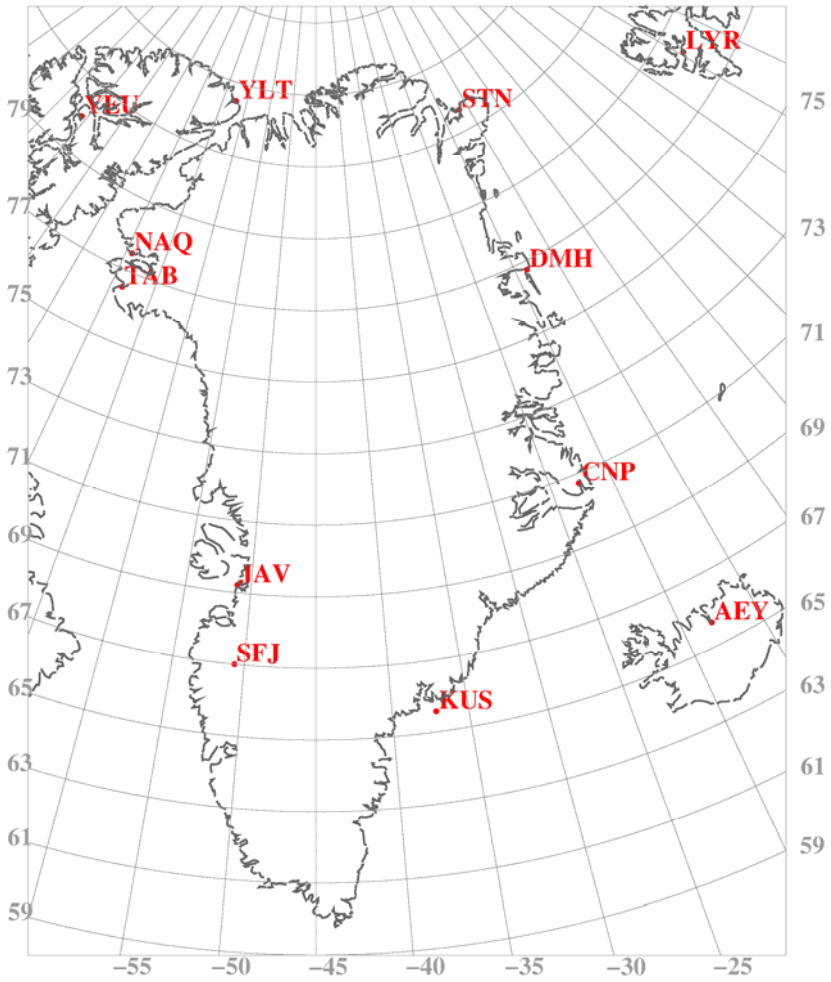
1101	GoPro DTU Started
1101	uEye DTU No record of today's flight
1150	ASIRAS PC1 Calibration
1150	ASIRAS PC1 Started
1158	at Swiss camp
1250	ASIRAS PC1 Stopped
1250	ASIRAS PC2 Started
1352	ASIRAS PC2 Stopped
1352	ASIRAS PC1 Started
1450	ASIRAS PC1 Stopped
1450	ASIRAS PC2 Started
1457	ASIRAS PC2 Stopped
1457	ASIRAS PC1 Calibration
1554	Landing
1555	GoPro DTU Stopped
1821:03	GoPro DTU Started
1845:00	Gopro DTU Stopped




CNP
AEY
71
69
67
65
-20
16.87
17.07
17.27
17.47
17.67
17.87
18.07
18.27
JD 129
CNP-AEY
129_CNP-AEY_air3.p

2 APPENDIX Airport codes

IATA		Location	Land	Latitude	Longitude
AEY		Akureyri	Iceland	65.659994	-18.072703
CNP		Constable Pynt	Greenland	70.7444	-22.6482
n/a	DMH	Danmarkshavn	Greenland	76.7704	-18.6581
JAV		Ilulissat	Greenland	69.217	-51.083
KUS		Kulusuk	Greenland	65.573611	-37.123611
LYR		Longyearbyen	Norway	78.2456	15.4991
NAQ		Qaanaaq	Greenland	77.50	-69.25
n/a	STN	Station Nord	Greenland	81.5971	-16.6569
SFJ		Kangerlussuaq	Greenland	67.006	-50.703
THU		Thule AB	Greenland	76.53	-68.71
YEU		Eureka	Canada	79.994444	-85.811944
YLT		CFS Alert	Canada	82.500	-62.325



3 APPENDIX Coordinates of GPS base stations

Date	DOY	Reference	Latitude (DMS)	Longitude (DMS)	Ellipsoidal Height (m)
17-03-2014	076	AEY	65 39 09.23884	-18 04 26.76372	67.879
19-03-2014	078	YEV1	68 18 30.64093	-133 30 00.97811	57.616
20-03-2014	079	YEV1	68 18 18.45919	-133 30 03.17712	56.475
20-03-2014	-	YEV2	68 18 18.40987	-133 30 03.14858	56.442
21-03-2014	080	YEV1	68 18 18.45892	-133 30 03.17578	56.482
21-03-2014	-	YEV2	68 18 18.41047	-133 30 03.14872	56.477
-	Av. 085 through 91	NRD[1)]	81 36 03.57120	-16 39 39.15407	70.965
26-03-2014	085	NRD	81 36 03.57115	-16 39 39.15415	70.962
26-03-2014	-	YLT1	82 30 39.30197	-62 19 47.09627	51.769
26-03-2014	-	YLT2	82 30 49.40560	-62 19 25.90823	48.959
27-03-2014	087	NRD	81 36 03.57113	-16 39 39.15412	70.957
27-03-2014	-	YLT1	82 30 39.31441	-62 19 46.99191	51.654
27-03-2014	-	YLT2	82 30 49.38878	-62 19 30.40805	49.640
28-03-2014	088	NRD	81 36 03.57121	-16 39 39.15422	70.972
29-03-2014	089	NRD	81 36 03.57126	-16 39 39.15390	70.972
30-03-2014	090	NRD	81 36 03.57121	-16 39 39.15412	70.967
1-04-2014	091	NRD	81 36 03.57119	-16 39 39.15388	70.962
27-04-2014	117	AEY[2)]	65 39 09.97075	-18 04 35.25812	67.616
28-04-2014	118	AEY	65 39 09.06148	-18 04 27.08078	67.506
2-05-2014	122	LYR	78 14 45.42000	15 30 15.15493	54.347
3-05-2014	123	LYR	78 14 45.43021	15 30 14.51373	54.407
6-05-2014	126	THU	76 32 08.32720	-68 43 57.00586	76.093
8-05-2014	128	JQA	70 43 56.60153	-52 41 40.35921	112.872

1) At Station Nord the antenna was fixed to the same building during the operation from there. This is the result of the averaging of all those days.
2) This reference is used for the measurement of the calibration-building near Akureyri airport. Data had to be cut away in the beginning and end of the original file in order to give a solution from AUSPOS.

4 Appendix – Overview of acquired ALS data

Date	DOY	Raw ALS file	Start time (dechr)	Stop time (dechr)	Angles (pitch, roll, heading)	dt (s)	Scan width limits
17-03-2014		76_114730.2dd	11.79282	12.26454	-1.70 0.23 0.0	0	
		76_121745.2dd	12.29556	12.78934		0	Few data
		76_161130.2dd	16.19184	16.25916	-1.70 0.16 0.0	0	0 251
	76	76_162015.2dd	16.33780	16.68650		0	
		76_175215.2dd	17.87096	18.14256		0	
		76_181200.2dd	18.20015	19.10542		0	
		76_190700.2dd	19.11676	20.09593		0	
18-03-2014		77_152045.2dd	15.32931	16.24424		0	
		77_161500.2dd	16.25052	17.24481	Transit	0	
	77	77_171515.2dd	17.25429	18.23472	-1.75 0.10 0.0	0	40 235
		77_181430.2dd	18.24178	19.23567	Poor EGI	0	
		77_191500.2dd	19.25160	19.89460		0	
19-03-2014		78_163200.2dd	16.53346	16.62471	Transit, no EGI	0	
		78_163910.2dd	16.65291	16.69650	OXTS on/off	0	
		78_164430.2dd	16.74179	17.00618	AIR1/3 on/off	0	
	78	78_170300.2dd	17.05015	17.89115		0	
		78_175400.2dd	17.90035	19.04073			
		78_213515.2dd	21.58756	22.93507			
		78_225630.2dd	22.94172	23.00254			
20-03-2014	79				No data	-	-
21-03-2014		80_143630.2dd	14.60841	14.73916	Few data	0	0 251
		80_150630.2dd	15.10844	15.99241		0	40 235
		80_160000.2dd	16.00009	16.27938		0	40 235
	80	80_162130.2dd	16.35846	17.16068	-1.75 0.20 0.0	0	40 235
		80_171015.2dd	17.17096	17.56470		0	40 240
		80_173430.2dd	17.57525	18.14388		0	40 240
		80_180900.2dd	18.15011	19.04213		0	40 240
		80_190300.2dd	19.05006	20.02372		0	40 240
23-03-2014		82_160815.2dd	16.13760	16.28897	-1.75 0.14 0.0	0	45 170
		82_161830.2dd	16.30843	17.19556	-1.75 0.14 0.0	0	45 170
		82_173815.2dd	17.63763	18.67500	-1.75 0.14 0.0	0	45 215
	82	82_184100.2dd	18.68345	18.92804	-1.75 0.14 0.0	0	45 215
		82_214145.2dd	21.69595	22.58035	-1.75 0.15 0.0	0	40 225
		82_223515.2dd	22.58757	23.42824	-1.75 0.15 0.0	0	40 225
		82_232600.2dd	23.43339	24.43366	-1.75 0.15 0.0	0	40 235
25-04-2014		84_132730.2dd	13.45840	14.32731		0	45 100
	84	84_142000.2dd	14.33340	14.84489		0	45 100
		84_145745.2dd	14.96261	15.55172		0	45 135
		84_160830.2dd	16.14175	16.83822	-1.75 0.10 0.0	0	45 175

26-04-2014		85_143315.2dd	14.55431	14.66501		0	
		85_144600.2dd	14.76681	15.65598		0	
		85_154000.2dd	15.66678	16.49589		0	
	85	85_163000.2dd	16.49994	17.50949		0	
		85_173100.2dd	17.51676	18.40972		0	
		85_182500.2dd	18.41674	19.50973		0	
		85_193100.2dd	19.51680	19.69919	-1.75 0.20 0.0	0	0 251
28-03-2014		87_145015.2dd	14.83760	15.64650		0	0 251
		87_153915.2dd	15.65421	16.40485		0	38 236
	87	87_162445.2dd	16.41258	17.43238	-1.75 0.20 0.0	0	38 236
		87_172615.2dd	17.43763	18.34576		0	38 236
		87_182115.2dd	18.35428	19.21803		0	38 236
		87_191345.2dd	19.22931	19.91895		0	38 236
29-03-2014		88_134500.2dd	13.75000	14.92879		-80337	
	88	88_145600.2dd	14.93333	16.15727		-80337	0 251
		88_161000.2dd	16.16667	16.99879		-80337	
		88_170030.2dd	17.00833	18.10272	-1.70 0.155 0.0	-80337	
30-03-2014		89_120900.2dd	12.15000	12.33389		-1	No data
		89_122100.2dd	12.35000	13.24589		-1	40 238
		89_131500.2dd	13.25000	14.24449		-1	40 238
	89	89_141500.2dd	14.25000	15.14128	-1.70 0.19 0.0	-1	40 238
		89_150900.2dd	15.15000	15.85441		-1	40 238
		89_155145.2dd	15.86250	16.66073		-1	40 238
		89_164000.2dd	16.66667	17.68553		-1	40 238
31-03-2014		90_161800.2dd	16.30000	17.24504		-1	
		90_171500.2dd	17.25000	18.17820		-1	
	90	90_181100.2dd	18.18333	19.06304	-1.70 0.22 0.0	-1	40 238
		90_190415.2dd	19.07083	20.08876		-1	
		90_200545.2dd	20.09583	20.62482		-1	
		90_203745.2dd	20.62917	21.27513	-1.70 0.23 0.0	-1	
1-04-2014		91_094900.2dd	9.81667	9.91849	Few data	-1	
	91	91_105600.2dd	10.93333	11.69326	-1.70 0.11 0.0	-1	
		91_114200.2dd	11.70000	12.40906	-1.70 0.10 0.0	-1	38 238
		91_132430.2dd	13.40833	13.84082		-1	
28-04-2014		118_114200.2dd	11.70000	12.30216	-1.75 0.21 0.1	-1	
	118	118_144600.2dd	14.76667	15.14086			
		118_152300.2dd	15.38333	15.65501			
		118_173530.2dd	17.59167	18.93404			
29-04-2014		119_095200.2dd	9.86667	10.45388			
		119_102930.2dd	10.49167	10.81314			
	119	119_105200.2dd	10.86667	11.29866	-1.80 0.09 0.0	0	
		119_111900.2dd	11.31667	12.22664			
		119_121400.2dd	12.23333	12.53146			
2-05-2014		122_105645.2dd	10.94583	12.13432			
	122	122_120920.2dd	12.15556	13.20887	-1.80 0.135 0.0	0	
		122_131300.2dd	13.21667	13.37263			

03-05-2014	123	123_091215.2dd	9.20429	9.78171			
		123_094900.2dd	9.81673	10.50787			
		123_103115.2dd	10.52083	11.38299	-1.80 0.135 0.0	0	
		123_112400.2dd	11.40000	12.27030			
		123_121700.2dd	12.28333	12.81253			
		123_145730.2dd	14.95833	15.27582	-1.80 0.11 0.0	-1	
		123_161200.2dd	16.20000	17.01178			
		123_170115.2dd	17.02083	17.77722			
05-05-2014	125	125_095600.2dd	9.93333	11.23883			
		125_111500.2dd	11.25000	12.19275			
		125_121200.2dd	12.20000	13.17890	-1.80 0.08 0.0	0	
		125_131115.2dd	13.18750	14.04402			
		125_140315.2dd	14.05417	14.35808			
06-05-2014	126	126_140440.2dd	14.07777	15.02407			
		126_150200.2dd	15.03333	15.62407	-1.80 0.15 0.0	0	
		126_153800.2dd	15.63333	15.94799			
07-05-2014	127	127_150530.2dd	15.09166	15.68717		0	
		127_154145.2dd	15.69583	16.47765		0	
		127_162900.2dd	16.48333	16.91851	-1.80 0.10 0.0	0	40 238
		127_165530.2dd	16.92500	17.87315		0	
		127_175245.2dd	17.87917	19.22052		0	
08-05-2014	128	128_130045.2dd	13.01250	13.31580			
		128_133400.2dd	13.56667	14.32400	OXTS		
		128_141950.2dd	14.33056	15.26373	-1.85 -0.13 0.0	0	
		128_151630.2dd	15.27500	16.01047			
		128_160915.2dd	16.15417	16.94145			
09-05-2014	129	129_115240.2dd	11.87778	12.77215		0	
		129_124645.2dd	12.77917	13.66537	-1.75 0.14 0.0*	0	
		129_134030.2dd	13.67500	14.51820		0	40 238
		129_143130.2dd	14.52500	14.99064		0	
		129_183030.2dd	18.50833	18.72983	-1.70 0.08 0.0	0	

*OXTS fitted at 11.88 (-1.85, -0.16, 0.0)

5 Appendix – Overview of acquired ASIRAS log-files

Date	File name	Start time (UTC)	End time (UTC)	Range window (m)	# Pulses
17-03-2014	A140317_00.log	12:26:59	12:33:30	90.00	972494
AEY test	A140317_01.log	12:33:34	12:45:19	90.00	1757490
	A140317_02.log	12:45:22	12:52:25	90.00	1052495
	A140317_03.log	15:23:41	15:24:27	90.00	105000
17-03-2014	A140317_00.log	16:21:44	16:52:20	90.00	4587471
	A140317_01.log	18:01:03	20:13:12	90.00	19819868
18-03-2014	A140318_00.log	15:24:29	17:14:27	90.00	16492393
	A140318_01.log	17:14:56	19:01:10	90.00	15927397
	A140318_02.log	19:01:35	20:02:35	90.00	9144942
19-03-2014	A140319_00.log	16:48:16	17:41:41	90.00	8009953
	A140319_01.log	17:42:02	19:10:29	90.00	13262414
	A140319_02.log	21:36:30	22:32:13	90.00	8352448
	A140319_03.log	22:32:46	22:59:11	90.00	3959974
20-03-2014					
21-03-2014	A140321_00.log	14:44:28	14:44:33	90.00	7500
	A140321_01.log	15:10:43	16:05:41	90.00	8239947
	A140321_02.log	16:06:07	16:06:09	90.00	0
	A140321_03.log	17:15:46	18:09:18	90.00	8024946
	A140321_04.log	18:09:32	18:13:04	90.00	0
	A140321_04.log	19:09:06	19:58:10	90.00	7354951
23-03-2012	A140323_00.log	14:43:59	14:44:38	90.00	95000
	A140323_01.log	14:45:32	14:45:38	90.00	12501
	A140323_02.log	14:48:41	14:48:57	90.00	37500
	A140323_03.log	16:10:06	17:13:18	90.00	9477436
	A140323_04.log	17:13:54	17:15:07	90.00	0
	A140323_05.log	18:09:16	18:52:35	90.00	6494957
	A140323_06.log	21:55:16	22:22:39	90.00	4102473
	A140323_07.log	22:24:52	22:54:36	90.00	4454971
	A140323_08.log	22:55:11	23:00:00	90.00	719996
	A140323_09.log	23:00:02	23:53:10	90.00	7967447
	A140323_10.log	23:53:44		90.00	
	A140323_10.log-2014-03-24		00:19:01	90.00	3787475
25-03-2014	A140325_00.log	13:42:59	14:38:27	90.00	8314949
	A140325_01.log	14:59:01	15:38:00	90.00	5844963
	A140325_02.log	15:50:20	15:51:10	90.00	122500
	A140325_03.log	16:09:23	16:42:17	90.00	4929967
26-03-2014	A140326_00.log	14:46:54	15:53:45	90.00	10024936
	A140326_01.log	15:54:20	16:48:34	90.00	8132445
	A140326_02.log	16:54:09	16:56:44	90.00	382498
	A140326_03.log	17:02:19	17:02:28	90.00	0
	A140326_04.log	17:16:20	18:18:52	90.00	9377437
	A140326_05.log	18:19:11	19:18:20	90.00	8869941
	A140326_06.log	19:18:35	19:32:50	90.00	2132486
	A140326_07.log	19:32:53	19:32:56	90.00	5001
	A140326_08.log	19:33:13	19:39:34	90.00	947494

28-03-2014	A140328_00.log	14:59:03	14:59:39	90.00	85000
	A140328_01.log	15:00:10	16:07:06	90.00	10034937
	A140328_02.log	16:07:27	17:29:30	90.00	12302420
	A140328_03.log	17:29:31	18:08:42	90.00	5872461
	A140328_04.log	18:09:16	19:12:59	90.00	9554936
	A140328_05.log	19:13:26	19:51:58	90.00	5774961
29-03-2014	A140329_00.log	13:47:23	15:01:51	90.00	11164930
	A140329_01.log	15:02:11	16:25:25	90.00	12479917
	A140329_02.log	16:25:43	17:06:24	90.00	6097459
	A140329_03.log	17:06:38	18:04:17	90.00	5702462
30-03-2014	A140330_00.log	12:26:04	13:25:37	90.00	8929945
	A140330_01.log	13:25:52		90.00	
	A140330_02.log	14:18:33	15:50:31	90.00	13789908
31-03-2014	A140331_00.log	17:30:55	18:46:33	90.00	11339924
	A140331_01.log	18:46:58	19:59:05	90.00	10812427
	A140331_02.log	20:01:54	21:12:10	90.00	10537430
01-04-2014	A140401_00.log	10:55:56	11:36:07	90.00	6022460
	A140401_01.log	11:37:29	12:18:37	90.00	6162459
28-04-2014	A140428_00.log	12:00:59	12:14:29	90.00	2019989
	A140428_01.log	12:15:16	12:15:27	90.00	22501
	A140428_02.log	13:33:33	13:34:49	90.00	184999
	A140428_03.log	13:35:55	13:37:35	90.00	247499
28-04-2014	A140428_04.log	14:48:18	15:33:27	90.00	6769955
	A140428_05.log	17:36:32	17:38:23	90.00	272498
	A140428_06.log	17:38:31	17:41:04	90.00	377498
	A140428_07.log	17:41:21	18:51:45	90.00	10554930
29-04-2014	A140429_00.log	09:54:47	10:05:28	90.00	
	A140429_01.log	10:45:50	11:50:47	90.00	9737436
	A140429_02.log	11:51:12	12:32:55	90.00	6254959
02-05-2014	A140502_00.log	10:57:23	12:09:28	90.00	10807428
	A140502_01.log	12:09:55	13:02:05	90.00	7819948
	A140502_02.log	13:02:28	13:19:49	90.00	2597482
03-05-2014	A140503_00.log	09:11:15	09:47:58	90.00	5502465
	A140503_01.log	09:48:20	10:57:12	90.00	10324931
	A140503_02.log	10:57:31	11:46:39	90.00	7364951
	A140503_03.log	11:46:56	12:46:28	90.00	8924941
	A140503_04.log	14:54:37	15:27:11	90.00	4882470
	A140503_05.log	16:11:20	17:00:22	90.00	7349951
	A140503_06.log	17:00:41	17:37:07	90.00	5459964
05-05-2014	A140505_00.log	09:58:04	10:54:42	90.00	8489945
	A140505_01.log	10:55:03	11:57:18	90.00	9327438
	A140505_02.log	11:57:46	13:10:50	90.00	10957427
	A140505_03.log	13:11:05	14:05:28	90.00	8154945
	A140505_04.log	14:05:41	14:20:45	90.00	2257485
06-05-2014	A140506_00.log	14:04:43	15:20:49	90.00	11409925
	A140506_01.log	15:21:38	15:54:28	90.00	4919968
07-05-2014	A140507_00.log	15:01:47	15:58:55	90.00	8564944
	A140507_01.log	15:59:09	16:59:00	90.00	8972440
	A140507_02.log	16:59:20	17:57:25	90.00	8704942
	A140507_03.log	17:57:46	18:55:19	90.00	8627443

	A140507_04.log	18:55:31	19:13:53	90.00	2749982
08-05-2014	A140508_00.log	12:57:59	13:57:02	90.00	8854943
	A140508_01.log	13:57:22	14:47:29	90.00	7514950
	A140508_02.log	14:47:42	15:47:06	90.00	8907441
	A140508_03.log	15:47:28	16:31:13	90.00	6559956
	A140508_04.log	16:31:31	16:55:52	90.00	3649975
09-05-2014	A140509_00.log	11:50:35	12:50:13	90.00	8937442
	A140509_01.log	12:50:32	13:52:06	90.00	9229939
	A140509_02.log	13:52:25	14:50:25	90.00	8694942
	A140509_03.log	14:50:37	14:57:49	90.00	1072494

6 APPENDIX ESA File name convention ESA data format

In general the filename contains a shortcut for the instrument and the start and stop time of the data file.

ASIRAS:
AS30AXX_ASIWL1BNNNN_SSSSSSSSSSSSSSS_PPPPPPPPPPPPPPP_0001.DBL

AS30AXX	ASIRAS (AS30), AXX number of data log
ASIWL1BNNNN	Level 1B data (L1B) processor version (NNNN)
SSSSSSSSSSSSSS	Start time given as YYYYMMDDTHHMMSS
PPPPPPPPPPPPPP	Stop time given as YYYYMMDDTHHMMSS

GPS
GPS_ANT_VER_SSSSSSSSSSSSSS-PPPPPP_0001.DAT

ANT	GPS antenna R for rear, and F for front
VER	Version
SSSSSSSSSSSSSS	Start time given as YYYYMMDDTHHMMSS
PPPPPP	Stop time given as HHMMSS

Inertial Navigation System (INS)
INS_ SSSSSSSSSSSSSS-PPPPPP_0001.DAT

SSSSSSSSSSSSSS	Start time given as YYYYMMDDTHHMMSS
PPPPPP	Stop time given as HHMMSS

Airborne laser scanner (ALS) full resolution
ALS_L1B_ SSSSSSSSSSSSSS-PPPPPP.DAT

L1B	Level 1B data
SSSSSSSSSSSSSS	Start time given as YYYYMMDDTHHMMSS
PPPPPP	Stop time given as HHMMSS

AEM data files
HEM_CMPID_SSSSSSSSSSSSSS_PPPPPPPPPPPPPP.dat

CMPID	Contains campaign name (3 letters + 2 digits of year), The id for the CryoVEx 2011 field campaign is given by CRV11.
SSSSSSSSSSSSSS	Start time given as YYYYMMDDTHHMMSS
PPPPPPPPPPPPPP	Stop time given as YYYYMMDDTHHMMSS

7 APPENDIX ESA data format

The following appendix has been adapted from Stenseng et al (2007). The format description for core products is taken from the "ASIRAS, product Description, Issue: 2.6.1" by Cullen (2010) and the users should refer to this document for detailed information. The definition of the types used in the binary files can be found in Table 15.

Table 7: Defintion of binary types used in the description of the file format

Type	Description	Size [Bytes]
uc	Unsigned character	1
sc	Signed character	1
us	Unsigned short integer	2
ss	Signed short integer	2
ul	Unsigned long integer	4
sl	Signed long integer	4
ull	Unsigned long long integer	8
sll	Signed long long integer	8
d	Double precision floating	8
f	Single precision floating	4
[n]	Array length n	

7.1 ASIRAS L1b

Processed L1b ASIRAS data is delivered in binary, big endian format as described by Cullen (2010) and Tables 16, 17 and 18.

The L1b product consists of two elements.

1. An ASCII header consisting of a main product header (MPH), a specific product header (SPH), and the data set descriptors (DSDs).
2. A binary, big endian measurement data set (MDS).

Table 8: ASIRAS main product header (MPH) format

Field #	Description	Units	Bytes	Format
Product Identification Information				
#01	PRODUCT=	keyword	8	8*uc
	quotation mark (")		1	uc
	Product File Name		62	uc
	quotation mark (")		1	uc
	newline character	terminator	1	uc

Continued on next page

Field #	Description	Units	Bytes	Format
#02	PROC_STAGE=	keyword	11	11*uc
	Processing stage code: N = Near-Real Time T = Test O = OFF Line (Systematic) R = Reprocessing L = Long Term Archive		1	uc
	newline character	terminator	1	uc
#03	REF_DOC=	keyword	8	8*uc
	quotation mark (")		1	uc
	Reference DFCB Document describing the product		23	23*uc
	quotation mark (")		1	uc
	newline character	terminator	1	uc
#04	Spare		40	40*uc
	newline character	terminator	1	uc
Data Processing Information				
#05	ACQUISITION_STATION=	keyword	20	20*uc
	quotation mark (")		1	uc
	Acquisition Station ID Filled by blanks		20	Kiruna
	quotation mark (")		1	uc
	newline character	terminator	1	uc
#06	PROC_CENTER=	keyword	12	12*uc
	quotation mark (")		1	uc
	Processing Center ID code		6	PDS
	quotation mark (")		1	uc
	newline character	terminator	1	uc
#07	PROC_TIME=	keyword	10	10*uc
	quotation mark (")		1	uc
	Processing Time (Product Generation Time)	UTC	27	dd-MMM-yyyy hh:mm:ss.uuuuuu
	quotation mark (")		1	uc
	newline character	terminator	1	uc
#08	SOFTWARE_VER=	Keyword	13	13*uc
	quotation mark (")		1	uc
	Processor name, up to 8 characters, software version number followed by trailer blanks if any. If not used set to blanks		14	14*uc ProcessorName/VV.rr
	quotation mark (")		1	uc
	newline character	terminator	1	uc
#09	Spare (blank characters)		40	40*uc
	newline character	terminator	1	uc

Continued on next page

Field #	Description	Units	Bytes	Format
Information on Time of Data				
#10	SENSING_START=	keyword	14	14*uc
	quotation mark (")		1	uc
	UTC start time of data sensing. This is the UTC start time of the Input Level 0 Product. If not used set to 27 blanks	UTC	27	dd-MMM-yyyy hh:mm:ss.uuuuuu
	quotation mark (")		1	uc
	newline character	terminator	1	uc
#11	SENSING_STOP=	keyword	13	13*uc
	quotation mark (")		1	uc
	UTC stop time of data sensing. This is the UTC stop time of the Input Level 0 Product. If not used set to 27 blanks	UTC	27	dd-MMM-yyyy hh:mm:ss.uuuuuu
	quotation mark (")		1	uc
	newline character	terminator	1	uc
#12	Spare (blank characters)		40	40*uc
	newline character	terminator	1	uc
Orbit Information				
#13	PHASE=	keyword	6	6*uc
	Phase Code: phase letter (A, B, \...) If not used set to X		1	uc
	newline character	terminator	1	uc
#14	CYCLE=	keyword	6	6*uc
	Cycle number. If not used set to +000		4	%+04d
	newline character	terminator	1	uc
#15	REL_ORBIT=	keyword	10	10*uc
	Relative Orbit Number at sensing start time. If not used set to +00000		6	%+06d
	newline character	terminator	1	uc
#16	ABS_ORBIT=	keyword	10	10*uc
	Absolute Orbit Number at sensing start time. If not used set to +00000		6	%+06d
	newline character	terminator	1	uc
#17	STATE_VECTOR_TIME=	keyword	18	18*uc
	quotation mark (")		1	uc
	UTC state vector time It is filled properly in case of usage of FOS Predicted Orbit information otherwise it shall be set to 27 blanks	UTC	27	dd-MMM-yyyy hh:mm:ss.uuuuuu
	quotation mark (")		1	uc
	newline character	terminator	1	uc

Continued on next page

Field #	Description	Units	Bytes	Format
#18	DELTA_UT1=	keyword	10	10*uc
	Universal Time Correction: DUT1 = UT1 - UTC Not used for ASIRAS. It shall be set to +.000000	s	8	%+08.6f
	<s>	units	3	3*uc
	newline character	terminator	1	uc
#19	X_POSITION=	keyword	11	11*uc
	X position in Earth Fixed Reference. If not used set to +0000000.000	m	12	%+012.3f
	<m>	units	3	3*uc
	newline character	terminator	1	uc
#20	Y_POSITION=	keyword	11	11*uc
	Y position in Earth Fixed Reference. If not used set to +0000000.000	m	12	%+012.3f
	<m>	units	3	3*uc
	newline character	terminator	1	uc
#21	Z_POSITION=	keyword	11	11*uc
	Z position in Earth Fixed Reference. If not used set to +0000000.000	m	12	%+012.3f
	<m>	units	3	3*uc
	newline character	terminator	1	uc
#22	X_VELOCITY=	keyword	11	11*uc
	X velocity in Earth Fixed Reference. If not used set to +0000.000000	m/s	12	%+012.6f
	<m/s>	units	5	5*uc
	newline character	terminator	1	uc
#23	Y_VELOCITY=	keyword	11	11*uc
	Y velocity in Earth Fixed Reference. If not used set to +0000.000000	m/s	12	%+012.6f
	<m/s>	units	5	5*uc
	newline character	terminator	1	uc
#24	Z_VELOCITY=	keyword	11	11*uc
	Z velocity in Earth Fixed Reference. If not used set to +0000.000000	m/s	12	%+012.6f
	<m/s>	units	5	5*uc
	newline character	terminator	1	uc
#25	VECTOR_SOURCE=	keyword	14	14*uc
	quotation mark (")		1	uc
	Source of Orbit State Vector Record FP = FOS predicted DN = DORIS Level 0 navigator DP = DORIS precise orbit FR = FOS Restituted DI = DORIS Preliminary		2	2*uc
	quotation mark (")		1	uc
	newline character	terminator	1	uc

Field #	Description	Units	Bytes	Format
#26	Spare (blank characters)		40	40*uc
	newline character	terminator	1	uc
SBT to UTC conversion information				
#27	UTC_SBT_TIME=	Keyword	13	13*uc
	quotation mark (")		1	uc
	Not used and set to 27 blanks		27	27*uc
	quotation mark (")		1	uc
	newline character	Terminator	1	uc
#28	SAT_BINARY_TIME=	Keyword	16	16*uc
	Satellite Binary Time Not used for ASIRAS/Cryosat and it to zeros		11	+0000000000
	newline character	Terminator	1	uc
#29	CLOCK_STEP =	Keyword	11	11*uc
	Clock Step Not used for ASIRAS/Cryosat and it to zeros		11	+0000000000
	<ps>	Units	4	4*uc
	newline character	Terminator	1	uc
#30	Spare (blank characters)		32	32*uc
	newline character	Terminator	1	uc
Leap Second Information				
#31	LEAP_UTC=	Keyword	9	9*uc
	quotation mark (")		1	uc
	UTC Time of the occurrence of the leap second. If a leap second occurred in the product window the field is set by a devoted function in the CFI EXPLORER_ORBIT library (see [EXPL_ORB-SUM] for details), otherwise it is set to 27 blanks. It corresponds to the time after the Leap Second occurrence (i.e. midnight of the day after the leap second)	UTC	27	dd-MMM-yyyy hh:mm:ss.uuuuuu
	quotation mark (")		1	uc
	newline character	terminator	1	uc
#32	LEAP_SIGN=	Keyword	10	10*uc
	Leap second sign If a leap second occurred in the product window the field is set to the expected value by a devoted function in the CFI EXPLORER_ORBIT library (see [EXPL_ORB-SUM] for details), otherwise it is set to +000.	S	4	%+04d
	newline character	terminator	1	uc

Continued on next page

Field #	Description	Units	Bytes	Format
#33	LEAP_ERR=	keyword	9	9*uc
	Leap second error flag. This field is always set to 0 considering that CRYOSAT products have true UTC times.		1	uc
	newline character	terminator	1	uc
#34	Spare (blank characters)		40	40*uc
	newline character	terminator	1	uc
Product Confidence Data Information				
#35	PRODUCT_ERR=	keyword	12	12*uc
	Product Error Flag set to 1 if errors have been reported in the product		1	uc
	newline character	terminator	1	uc
Product Size Information				
#36	TOT_SIZE=	keyword	9	9*uc
	Total size of the product	bytes	21	%+021d
	<bytes>	units	7	7*uc
	newline character	terminator	1	uc
#37	SPH_SIZE=	keyword	9	9*uc
	Length of the SPH	bytes	11	%+011d
	<bytes>	units	7	7*uc
	newline character	terminator	1	uc
#38	NUM_DSD=	keyword	8	8*uc
	Number of Data Set Descriptors, including spares and all other types of DSDs		11	%+011d
	newline character	terminator	1	uc
#39	DSD_SIZE=	keyword	9	9*uc
	Length of each DSD	bytes	11	%+011d
	<bytes>	units	7	7*uc
	newline character	terminator	1	uc
#40	NUM_DATA_SETS=	keyword	14	14*uc
	Number of attached Data Sets (note that not all the DSDs have a DS attached)		11	%+011d
	newline character	terminator	1	uc
#41	CRC=	keyword	4	4*uc
	Cyclic Redundancy Code computed as overall value of all records of the Measurement Data Set. If not computed it shall be set to -00001		6	%+06d
	newline character	terminator	1	uc
#42	Spare (blank characters)		29	29*uc
	newline character	terminator	1	uc
Total				**1247**

Table 9: ASIRAS specific product header (SPH) format

Field #	Description	Units	Bytes	Format
Product description and identification				
#1	SPH_DESCRIPTOR=	keyword	15	15*uc
	quotation mark (")		1	uc
	ASCII string describing the product Set to ASI_SAR_1B SPECIFIC HEADER		28	28*uc
	quotation mark (")		1	uc
	newline character	terminator	1	uc
Product Time information				
#2	START_RECORD_TAI_TIME=	keyword	22	22*uc
	quotation mark (")		1	uc
	TAI of the first record in the Main MDS of this product	TAI	27	dd-MMM-yyyy hh:mm:ss.uuuuuu
	quotation mark (")		1	uc
	newline character	terminator	1	uc
#3	STOP_RECORD_TAI_TIME=	keyword	21	21*uc
	quotation mark (")		1	uc
	TAI of the last record in in the Main MDS of this product	TAI	27	dd-MMM-yyyy hh:mm:ss.uuuuuu
	quotation mark (")		1	uc
	newline character	terminator	1	uc
Product Orbit Information				
#4	ABS_ORBIT_START=	keyword	16	16*uc
	Absolute Orbit Number at Product Start Time		6	%06d
	newline character	terminator	1	uc
#5	REL_TIME_ASC_NODE_START=	Keyword	24	24*uc
	Relative time since crossing ascending node time relative to start time of data sensing	s	11	%011.6f
	<s>	units	3	3*uc
	newline character	terminator	1	uc
#6	ABS_ORBIT_STOP=	keyword	15	15*uc
	Absolute Orbit Number at Product Stop Time		6	%06d
	newline character	terminator	1	uc
#7	REL_TIME_ASC_NODE_STOP=	Keyword	23	23*uc
	Relative time since crossing ascending node time relative to stop time of data sensing	s	11	%011.6f
	<s>	units	3	3*uc
	newline character	terminator	1	uc

Continued on next page

Field #	Description	Units	Bytes	Format
#8	EQUATOR_CROSS_TIME_UTC=	Keyword	23	23*uc
	quotation mark (")		1	uc
	Time of Equator crossing at the ascending node of the sensing start time	UTC	27	dd-MMM-yyyy hh:mm:ss.uuuuuu
	quotation mark (")		1	uc
	newline character	terminator	1	uc
#9	EQUATOR_CROSS_LONG=	Keyword	19	19*uc
	Longitude of Equator Crossing at the ascending node of the sensing start time (positive East, 0 = Greenwich) referred to WGS84	s	11	%+011d
	<10-6degE>	units	10	10*uc
	newline character	terminator	1	uc
#10	ASCENDING_FLAG=	keyword	15	15*uc
	Orbit Orientation at the sensing start A= Ascending D= Descending		1	uc
	newline character	terminator	1	uc
Product Location Information				
#11	START_LAT=	keyword	10	10*uc
	WGS84 latitude of the first record in the Main MDS (positive north)	[10-6 deg]	11	%+011d
	<10-6degN>	units	10	10*uc
	newline character	terminator	1	uc
#12	START_LONG=	keyword	11	11*uc
	WGS84 longitude of the first record in the Main MDS (positive East, 0 = Greenwich)	[10-6 deg]	11	%+011d
	<10-6degE>	units	10	10*uc
	newline character	terminator	1	uc
#13	STOP_LAT=	keyword	9	9*uc
	WGS84 latitude of the last record in the Main MDS (positive north)	[10-6 deg]	11	%+011d
	<10-6degN>	units	10	10*uc
	newline character	terminator	1	uc
#14	STOP_LONG	keyword	10	10*uc
	WGS84 longitude of the last record in the Main MDS (positive East, 0 = Greenwich)	[10-6 deg]	11	%+011d
	<10-6degE>	units	10	10*uc
	newline character	terminator	1	uc
#15	Spare (blank characters)		50	50*uc
	newline character	terminator	1	uc

Field #	Description	Units	Bytes	Format
Level 0 Quality information				
#16	L0_PROC_FLAG=	keyword	13	13*uc
	Processing errors significance flag (1 or 0). 1 if the percentage of SIRAL packets free of processing errors is less than the acceptable threshold		1	uc
	newline character	terminator	1	uc
#17	L0_PROCESSING_QUALITY=	keyword	22	22*uc
	Percentage of quality checks successfully passed during the SP processing (max allowed +10000)	[10-2%]	6	%+06d
	<10-2%>	units	7	7*uc
	newline character	terminator	1	uc
#18	L0_PROC_THRESH=	keyword	15	15*uc
	Minimum acceptable percentage of quality threshold that must be passed during SP processing (max allowed +10000)	[10-2%]	6	%+06d
	<10-2%>	units	7	7*uc
	newline character	terminator	1	uc
#19	L0_GAPS_FLAG=	keyword	13	13*uc
	Gaps significance flag (1 or 0). 1 if gaps (either caused by extraction or alignment failures) were detected during the SP processing		1	uc
	newline character	terminator	1	uc
#20	L0_GAPS_NUM=	keyword	12	12*uc
	Number of gaps detected during the SP processing (no gaps indicated as +0000000)		8	%+08d
	newline character	terminator	1	uc
#21	Spare (blank characters)	ascii	50	50*uc
	newline character	terminator	1	uc
ASIRAS Instrument Configuration				
#22	ASI_OP_MODE=	keyword	12	12*uc
	quotation mark (")		1	uc
	ASIRAS Operative Mode: HAM LAM (strings shorter than 10 are filled in with blanks)		10	10*uc
	quotation mark (")		1	uc
	newline character	terminator	1	uc

Field #	Description	Units	Bytes	Format
#23	ASI_CONFIGURATION=	keyword	18	17*uc
	quotation mark (")		1	uc
	SIRAL Configuration: RX_1 RX_2 BOTH UNKNOWN (strings shorter than 7 are filled in with blanks)		7	7*uc
	quotation mark (")		1	uc
	newline character	terminator	1	uc
Surface Statistics				
#24	OPEN_OCEAN_PERCENT=	keyword	19	19*uc
	Percentage of records detected on open ocean or semi-enclosed seas	[10-2%]	6	%+06d
	<10-2%>	units	7	7*uc
	newline character	terminator	1	uc
#25	CLOSE_SEA_PERCENT=	keyword	18	18*uc
	Percentage of records detected on seas or inland lakes	[10-2%]	6	%+06d
	<10-2%>	units	7	7*uc
	newline character	terminator	1	uc
#26	CONTINENT_ICE_PERCENT=	keyword	22	22*uc
	Percentage of records detected on continental ice	[10-2%]	6	%+06d
	<10-2%>	units	7	7*uc
	newline character	terminator	1	Uc
#27	LAND_PERCENT Keyword 13 13*uc			
	Percentage of records detected on land	[10-2%]	6	%+06d
	<10-2%>	units	7	7*uc
	newline character	terminator	1	uc
#28	Spare (blank characters)	ascii	50	50*uc
	newline character	terminator	1	uc
Level 1 Processing information				
#29	L1B_PROD_STATUS=	keyword	16	16*uc
	Complete/Incomplete Product Completion Flag (0 or 1). 1 if the Product as a duration shorter the input Level 0		1	uc
	newline character	terminator	1	uc
#30	L1B_PROC_FLAG=	keyword	14	14*uc
	Processing errors significance flag (1 or 1 if the percentage of DSR free of processing errors is less than the acceptable threshold		1	uc
	newline character	terminator	1	uc

Field #	Description	Units	Bytes	Format
#31	L1B_PROCESSING_QUALITY=	keyword	23	23*uc
	Percentage of quality checks successfully passed during Level 1B processing (max allowed +10000)	[10-2%]	6	%+06d
	<10-2%>	units	7	7*uc
	newline character	terminator	1	uc
#32	L1B_PROC_THRESH=	keyword	16	16*uc
	Minimum acceptable percentage of quality threshold that must be passed during Level 1B processing (max allowed +10000)	[10-2%]	6	%+06d
	<10-2%>	units	7	7*uc
	newline character	terminator	1	uc
#33	Spare (blank characters)	ascii	50	50*uc
	newline character	terminator	1	uc
Total				**1112**

Table 10: ASIRAS data set descriptors (DSD) format

Field #N	Description	Units	Bytes	Format
DSD Section				
#N.1	DS_vvvvvvvvvvvvvvv	keyword	8	8*uc
	quotation mark (")		1	uc
	Name describing the Data Set		28	28*uc
	quotation mark (")		1	uc
	newline character	terminator	1	uc
#N.2	DS_TYPE=	keyword	8	8*uc
	Type of Data Set. It can be: M = Measurement R = Reference		1	uc
	newline character	terminator	1	uc
	External Product Reference			
External Product Reference				
#N.3	FILENAME=	keyword	9	9*uc
	quotation mark (")		1	uc
	Name of the Reference File. Used if DS_TYPE is set to R. It is left trailer blanks. The file name If not used it is set to 62 blanks.		62	62*uc
	quotation mark (")		1	uc
	newline character	terminator	1	uc
	Position and site of DS			

Field #N	Description	Units	Bytes	Format
Position and size of DS				
#N.4	DS_OFFSET=	keyword	10	10*uc
	Length in bytes of MPH + SPH DS size of previous Data Set (if	bytes	21	%+021d
	<bytes>	units	7	7*uc
	newline character	terminator	1	uc
#N.5	DS_SIZE=	keyword	8	8*uc
	Length in bytes of the attached Used if DS_TYPE is set to M If not used set to 0	bytes	21	%+021d
	<bytes>	units	7	7*uc
	newline character	terminator	1	uc
	Number and length of DSRs			
Number and length of DSRs				
#N.6	NUM_DSR=	keyword	8	8*uc
	Number of Data Set Records		11	%+011d
	newline character	terminator	1	uc
#N.7	DSR_SIZE=	keyword	9	9*uc
	Length in bytes of the Data Set If not used set to +0 If variable set to -1	bytes	11	%+011d
	<bytes>	units	7	7*uc
	newline character	terminator	1	uc
#N.8	Spare	ascii	32	32*uc
	newline character	terminator	1	uc
Total				**280**

The MDS can be further divided into five parts as described below:

1. Time and Orbit Group (20 blocks per record)
2. Measurements Group (20 blocks per record)
3. Corrections Group (one block per record)(Zeroed for ASIRAS)
4. Average waveforms Group (one block per record)(Zeroed for ASIRAS)
5. Waveform Group (20 blocks per record)

Table 11: ASIRAS measurement data set (MDS) format

Identifier	Description	Units	Type	Size [Bytes]
Time & Orbit Group Repeated 20 times				
1	Days	TAI	sl	4
2	Seconds		ul	4
3	Microseconds		ul	4
4	Spare		sl	4
5	Spare		us	2

Identifier	Description	Units	Type	Size [Bytes]
6	Spare		us	2
7	Instrument Config		ul	4
8	Burst Counter		ul	4
9	Geodetic latitude of	10^{-7} Deg	sl	4
10	Longitude of ASIRAS	10^{-7} Deg	sl	4
11	WGS-84 ellipsoidal	10^{-3} m	sl	4
12	Altitude rate determined	10^{-6} m/s	sl	4
13	Velocity [x,y,z], described	10^{-3} m/s	sl	3*4
14	Real antenna beam	10^{-6} m	sl	3*4
15	Interferometer baseline	10^{-6} m	sl	3*4
16	Measurement Confident		ul	4
Measurements Group Repeated 20 times				
17	Window delay	10-12 s	sll	8
18	Spare		sl	4
19	OCOG width	Range bins*100	sl	4
20	OCOG or threshold	10^{-3} m	sl	4
21	Surface elevation derived	10^{-3} m	sl	4
22	AGC Channel 1	dB/100	sl	4
23	AGC Channel 2	dB/100	sl	4
24	Total fixed gain Ch1	dB/100	sl	4
25	Total fixed gain Ch2	dB/100	sl	4
26	Transmit Power	10^{-6} Watts	sl	4
27	Doppler range correction	10^{-3} m	sl	4
28	Instrument range	10^{-3} m	sl	4
29	Instrument range	10^{-3} m	sl	4
30	Spare		sl	4
31	Spare		sl	4
32	Internal phase correction	10^{-6} rad	sl	4
33	External phase correction	10^{-6} rad	sl	4
34	Noise power	dB/100	sl	4
35	Roll	10^{-3} Deg	ss	2
36	Pitch	10^{-3} Deg	ss	2
37	Yaw	10^{-3} Deg	ss	2
38	Spare		ss	2
39	Heading	10^{-3} Deg	sl	4
40	Standard deviation of roll	10^{-4} Deg	us	2
41	Standard deviation of	10^{-4} Deg	us	2
42	Standard deviation of yaw	10^{-4} Deg	us	2
Corrections Group Once per record				
	Empty for ASIRAS			
43	Spare		uc	64*1
Average pulse-width limited Waveform group Once per record				
	Empty for ASIRAS			
44	Spare		uc	8236*1

Identifier	Description	Units	Type	Size [Bytes]
Multilooked Waveform Group Repeated 20 times				
45	Multi-looked Power Echo.	Counts (0-65535)	us	4096*2
46	Linear scale factor, A		sl	4
47	Power of 2 scale factor,B		sl	4
48	Number of multilooked		us	2
49	Flags		us	2
50	Beam behaviour		us	50*2
Total				**177940**

7.2 GPS

Processed DGPS data is delivered in binary, big endian format with each record formated as described by Cullen (2010) and Table 20.

Table 12: GPS file format

Identifier	Description	Unit	Type	Size [Bytes]
1	Days (MJD)	UTC	sl	4
2	Seconds		ul	4
3	Microseconds		ul	4
4	Latitude	10^{-7} deg	sl	4
5	Longitude	10^{-7} deg	sl	4
6	Geodetic ellipsoidal height (WGS-84)	m	d	8
7	Spare_7	N/A	d	8
8	Spare_8	N/A	d	8
9	Spare_9	N/A	d	8
10	Spare_10	N/A	d	8
Total				**72**

7.3 INS

Processed INS data is delivered in binary, big endian format with each record formatted as described by Cullen (2010) and Table 21.

Table 13: INS file format

Identifier	Description	Unit	Type	Size [Bytes]
1	Days (MJD)	UTC	sl	4
2	Seconds		sl	4
3	Microseconds		sl	4
4	Latitude (WGS-84)	Deg	d	8
5	Longitude	Deg	d	8
6	Ground speed	Kts	d	8
7	True Track	Deg	d	8
8	True Heading	Deg	d	8
9	Wind Speed	Kts	d	8
10	Wind Direction	Deg	d	8
11	Magnetic Heading	Deg	d	8
12	Pitch	Deg	d	8
13	Roll	Deg	d	8
14	Pitch Rate	deg/s	d	8
15	Roll Rate	deg/s	d	8
16	Yaw Rate	deg/s	d	8
17	Body longitudinal	G	d	8
18	Body lateral Acceleration	G	d	8
19	Body normal acceleration	G	d	8
20	Vertical Acceleration in G	G	d	8
21	Velocity Inertial Vertical	ft/min	d	8
22	Velocity North-South	Kts	d	8
23	Velocity East-west	Kts	d	8
Total				**172**

7.4 Laser scanner (ALS)

Processed ALS data is delivered in binary, little endian format with each record formatted as described in Table 22. Note that time is in decimal hours since the beginning of the day with respect to UTC time.

Table 14: ALS file format

Identifier	Description	Unit	Type	Size [Bytes]
Header				
1	Header Size	bytes	uc	1
2	Number of scan lines, N_{als_scan}	lines	ul	4
3	Number of data points per line, N_{als_dppl}	points	uc	1
4	Bytes per line, N_{als_bbl}	bytes	us	2
5	Bytes sec line	bytes	ull	8
6	Year of acquisition	UTC	us	2
7	Month of acquisition	UTC	uc	1
8	Day of acquisition	UTC	uc	1
9	Acquisition Start time (Seconds of day)	UTC	ul	4
10	Acquisition Stop time (Seconds of day)	UTC	ul	4
11	Device name		uc	8
Total				**36**
Time stamp array				
1	Array of time stamps for each scan line	UTC	ul	$4*N_{als\_scan}$
Total				**$4*N_{als\_scan}$**
DEM Record Repeated N_{als_scan} times				
1	Array of time stamps for each point	UTC	d	$8*N_{als\_dppl}$
2	Array of latitudes for each point	degrees	d	$8*N_{als\_dppl}$
3	Array of longitudes for each point	degrees	d	$8*N_{als\_dppl}$
2	Array of ellipsoidal heights for each point	meter	d	$8*N_{als\_dppl}$
Total				**N_{als_bbl}**

7.5 Vertical Camera

Approximate time and position of the vertical camera when a picture is taken is delivered in windows ASCII format as described in Table 24 and all individual pictures are in JPEG format. Each ASCII line gives the filename, time and position for the named picture. If no DGPS data is available the time and position is replaced with the string “No position available”.

Table 15: Position file format for vertical images

Identifier	Description	Unit
1	JPEG filename	
2	Decimal hours	hour
3	Latitude (WGS-84)	deg
4	Longitude	deg
5	Geodetic ellipsoidal height	m
6	Newline characters "\r \n"	

8 APPENDIX Processed GPS data in ESA format

Date	Filename	Start time (Sec of day)	Stop time (Sec of day)	File size
17-03-2014	GPS_F_20140317T115828_125207_0001	43108	46327	1.3
17-03-2014	GPS_F_20140317T142517_201800_0001	51917	73080	0.2
18-03-2014	GPS_F_20140318T115920_141646_0001	431620	51406	0.5
18-03-2014	GPS_F_20140318T144703_204225_0001	53223	74545	1.3
19-03-2014	GPS_R_20140319T162434_202052_0001	59074	73252	0.9
19-03-2014	GPS_F_20140319T212306_233905_0001	76986	85145	0.5
21-03-2014	GPS_F_20140321T141519_203550_0001	51319	74150	1.4
23-03-2014	GPS_F_20140323T141014_185744_0001	51014	68264	1.0
23-03-2014	GPS_F_20140323T202146_235943_0001	73306	86383	0.8
23-03-2014	GPS_F_20140323T202146_242825_0001	73306	88105	0.9
24-03-2014	GPS_F_20140324T000016_002825_0001	16	1705	0.1
25-03-2014	GPS_F_20140325T130752_165319_0001	47272	60799	0.8
25-03-2014	GPS_F_20140325T180105_204752_0001	64865	74872	0.6
26-03-2014	GPS_F_20140326T140533_194309_0001	50733	71829	1.2
28-03-2014	GPS_F_20140328T144002_195709_0001	52802	71829	1.1
29-03-2014	GPS_F_20140329T133436_180957_0001	48876	65397	1.0
30-03-2014	GPS_F_20140330T120251_174221_0001	43371	63741	1.2
31-03-2014	GPS_F_20140331T160345_212556_0001	57825	77156	1.2
01-04-2014	GPS_F_20140401T093622_151822_0001	34582	55102	1.2
28-04-2014	GPS_F_20140428T113705_121929_0001	41825	44369	0.2
28-04-2014	GPS_F_20140428T155824_191724_0001	57504	69444	0.7
29-04-2014	GPS_F_20140429T092119_134700_0001	33679	49620	1.0
02-05-2014	GPS_F_20140502T094255_140001_0001	34975	50401	0.9
03-05-2014	GPS_F_20140503T081026_133242_0001	29426	48762	1.2
03-05-2014	GPS_F_20140503T140419_174742_0001	50659	64062	0.8
05-05-2014	GPS_F_20140505T093748_150954_0001	34668	54594	1.2
06-05-2014	GPS_F_20140506T120824_171830_0001	43704	62310	1.1
07-05-2014	GPS_F_20140507T135853_194741_0001	50333	71261	1.3
08-05-2014	GPS_F_20140508T115756_171421_0001	43076	62064	1.1
09-05-2014	GPS_F_20140509T104925_155424_0001	38965	57264	0.5
09-05-2014	GPS_F_20140509T161548_184457_0001	58548	67497	1.1

9 APPENDIX Processed INS data in ESA format

Date	Filename	Start time (Sec of day)	Stop time (Sec of day)	File size (Mb)
17-03-2014	INS_20140317T120300_124801_0001	43380	46081	4.6
17-03-2014	INS_20140317T142322_201726_0001	51802	73046	36.5
18-03-2014	INS_20140318T122436_141613_0001	44676	51373	11.5
18-03-2014	INS_20140318T150000_203901_0001	54000	74341	35.0
19-03-2014	INS_20140319T163000-175244_0001	59400	64364	8.5
19-03-2014	INS_20140319T175315-202018_0001	64395	73218	15.2
19-03-2014	INS_20140319T213000_233601_0001	77400	84961	13.0
21-03-2014	INS_20140321T142848_203337_0001	52128	74017	37.7
23-03-2014	INS_20140323T142248_185624_0001	51768	68184	28.2
23-03-2014	INS_20140323T202436-235924_0001	73476	86364	22.2
23-03-2014	INS_20140323T202436-242808_0001	73476	88088	25.1
24-03-2014	INS_20140324T000012-002808_0001	12	1688	2.9
25-03-2014	INS_20140325T131424_165024_0001	47664	60624	22.3
25-03-2014	INS_20140325T180636_201831_0001	65196	73111	13.6
26-03-2014	INS_20140326T143000_194201_0001	52200	70921	32.2
28-03-2014	INS_20140328T144800_195513_0001	53280	71713	31.7
29-03-2014	INS_20140329T134200_180601_0001	49320	65161	27.2
30-03-2014	INS_20140330T121500_174125_0001	44100	63685	33.7
31-03-2014	INS_20140331T160936_212325_0001	58176	77005	32.4
01-04-2014	INS_20140401T094836_151725_0001	35316	55045	33.9
28-04-2014	INS_20140428T114500_121913_0001	42300	44353	3.5
28-04-2014	INS_20140428T160237_191703_0001	57757	69423	20.1
29-04-2014	INS_20140429T094348_134349_0001	35028	49429	24.8
02-05-2014	INS_20140502T100000-135925_0001	36000	50365	24.7
03-05-2014	INS_20140503T081948_133113_0001	29988	48673	32.1
03-05-2014	INS_20140503T144200_174613_0001	52920	63973	19.0
05-05-2014	INS_20140505T094800_150825_0001	35280	54505	33.1
06-05-2014	INS_20140506T122700_171801_0001	44820	62281	30.0
07-05-2014	INS_20140507T141536_194707_0001	51336	71227	34.2
08-05-2014	INS_20140508T122400_171407_0001	44640	62047	29.9
09-05-2014	INS_20140509T110448_155437_0001	39888	57277	29.9
09-05-2014	INS_20140509T162436_184407_0001	59076	67447s	14.4

10 APPENDIX Processed ALS data in ESA format

Date	Filename	Start time (Sec of day)	Stop time (Sec of day)	File size (MB)
2014-03-17	ALS_L1B_20140317T123112_123259	45072	45179	35.0
2014-03-17	ALS_L1B_20140317T123448_123712	45288	45432	46.7
2014-03-17	ALS_L1B_20140317T162016_164109	58816	60069	384.2
2014-03-17	ALS_L1B_20140317T175215_180833	64335	65313	65.3
2014-03-17	ALS_L1B_20140317T181200_190619	65520	68779	951.4
2014-03-17	ALS_L1B_20140317T190700_200545	68820	72345	1.143.1
2014-03-21	ALS_L1B_20140321T150630_155932	54390	57572	1.032.1
2014-03-21	ALS_L1B_20140321T160000_161538	57600	58538	301.7
2014-03-21	ALS_L1B_20140321T162130_170938	58890	61778	922.4
2014-03-21	ALS_L1B_20140321T171015_173352	61815	63232	459.7
2014-03-21	ALS_L1B_20140321T173430_180837	63270	65317	663.9
2014-03-21	ALS_L1B_20140321T180900_190231	65340	68551	1.041.3
2014-03-21	ALS_L1B_20140321T190300_200125	68580	72085	1.136.8
2014-03-23	ALS_L1B_20140323T160815_161707	58095	58627	148.4
2014-03-23	ALS_L1B_20140323T170208_171000	61328	61800	13.3
2014-03-23	ALS_L1B_20140323T173815_184029	63495	67229	1.203.8
2014-03-23	ALS_L1B_20140323T184100_185535	67260	68135	274.1
2014-03-23	ALS_L1B_20140323T185136_185201	67896	67921	8.1
2014-03-23	ALS_L1B_20140323T214411_223449	78251	81289	873.8
2014-03-23	ALS_L1B_20140323T223515_232541	81315	84341	952.6
2014-03-23	ALS_L1B_20140323T232600_242601	84360	87961	1.057.4
2014-03-25	ALS_L1B_20140325T132730_141938	48450	51578	925.5
2014-03-25	ALS_L1B_20140325T142533_143633	51933	52593	178.6
2014-03-25	ALS_L1B_20140325T145824_151903	53904	55143	383.0
2014-03-25	ALS_L1B_20140325T160930_164957	58170	60597	786.7
2014-03-26	ALS_L1B_20140326T144613_153921	53173	56361	992.3
2014-03-26	ALS_L1B_20140326T154000_162945	56400	59385	967.4
2014-03-26	ALS_L1B_20140326T163000_173034	59400	63034	905.7
2014-03-26	ALS_L1B_20140326T173100_182434	63060	66274	1.042.6
2014-03-26	ALS_L1B_20140326T182500_193034	66300	70234	1.276.1
2014-03-26	ALS_L1B_20140326T193100_194157	70260	70917	212.6
2014-03-26	ALS_L1B_20140326T193600_193639	70560	70599	12.8
2014-03-28	ALS_L1B_20140328T145445_145934	53685	53974	83.3
2014-03-28	ALS_L1B_20140328T153915_162417	56355	59057	876.3
2014-03-28	ALS_L1B_20140328T162445_172556	59085	62756	1.190.5
2014-03-28	ALS_L1B_20140328T172615_182044	62775	66044	1.060.2
2014-03-28	ALS_L1B_20140328T182115_191304	66075	69184	1.000.1

Continued on next page

Date	Filename	Start time (Sec of day)	Stop time (Sec of day)	File size (MB)
2014-03-28	ALS_L1B_20140328T191345_195418	69225	71658	788.9
2014-03-29	ALS_L1B_20140329T134500_145543	49500	53743	1.240.2
2014-03-29	ALS_L1B_20140329T145600_160926	53760	58166	1.428.7
2014-03-29	ALS_L1B_20140329T161001_165955	58201	61195	971.1
2014-03-29	ALS_L1B_20140329T170030_180609	61230	65169	1.276.8
2014-03-30	ALS_L1B_20140330T122100_131444	44460	47684	1.045.4
2014-03-30	ALS_L1B_20140330T131500_141439	47700	51279	1.160.6
2014-03-30	ALS_L1B_20140330T141500_150827	51300	54507	1.040.1
2014-03-30	ALS_L1B_20140330T150900_155114	54540	57074	821.9
2014-03-30	ALS_L1B_20140330T155145_163937	57105	59977	931.3
2014-03-30	ALS_L1B_20140330T164000_174106	60000	63666	1.188.5
2014-03-31	ALS_L1B_20140331T161946_170240	58786	61360	800.7
2014-03-31	ALS_L1B_20140331T171500_181040	62100	65440	1.083.2
2014-03-31	ALS_L1B_20140331T181100_190345	65460	68625	1.026.4
2014-03-31	ALS_L1B_20140331T190415_200518	68655	72318	1.187.9
2014-03-31	ALS_L1B_20140331T200545_203728	72345	74248	617.1
2014-03-31	ALS_L1B_20140331T203745_211629	74265	76589	753.6
2014-04-01	ALS_L1B_20140401T094904_095505	35344	35705	76.2
2014-04-01	ALS_L1B_20140401T105600_114134	39360	42094	886.7
2014-04-01	ALS_L1B_20140401T114200_122135	42120	44495	770.4
2014-04-28	ALS_L1B_20140428T121048_121159	43848	43919	23.3
2014-04-29	ALS_L1B_20140429T095200_102709	35520	37629	647.6
2014-04-29	ALS_L1B_20140429T102930_104340	37770	38620	21.2
2014-04-29	ALS_L1B_20140429T105216_111755	39136	40675	491.7
2014-04-29	ALS_L1B_20140429T111900_121335	40740	44015	1.061.0
2014-04-29	ALS_L1B_20140429T121358_123153	44038	45113	306.8
2014-05-02	ALS_L1B_20140502T105743_120803	39463	43683	1.361.0
2014-05-02	ALS_L1B_20140502T120920_131231	43760	47551	1.220.2
2014-05-02	ALS_L1B_20140502T131258_132130	47578	48090	150.9
2014-05-03	ALS_L1B_20140503T091314_094328	33194	35008	546.6
2014-05-03	ALS_L1B_20140503T095459_102615	35699	37575	599.9
2014-05-03	ALS_L1B_20140503T103221_112258	37941	40978	961.2
2014-05-03	ALS_L1B_20140503T112400_121613	41040	44173	1.015.9
2014-05-03	ALS_L1B_20140503T121700_124844	44220	46124	602.3
2014-05-03	ALS_L1B_20140503T145729_150504	53849	54304	132.28
2014-05-03	ALS_L1B_20140503T161200_170041	58320	61241	939.8
2014-05-03	ALS_L1B_20140503T170115_174636	61275	63996	844.1
2014-05-05	ALS_L1B_20140505T095600_111419	35760	40459	1.524.0
2014-05-05	ALS_L1B_20140505T111500_121133	40500	43893	1.100.5
2014-05-05	ALS_L1B_20140505T121200_131044	43920	47444	1.142.7
2014-05-05	ALS_L1B_20140505T131115_140238	47475	50558	999.8
2014-05-05	ALS_L1B_20140505T140315_141953	50595	51593	317.0
2014-05-06	ALS_L1B_20140506T140620_150126	50780	54086	967.2
2014-05-06	ALS_L1B_20140506T150200_153511	54120	56111	507.3
2014-05-06	ALS_L1B_20140506T154302_155331	56582	57211	148.6

Continued on next page

Date	Filename	Start time (Sec of day)	Stop time (Sec of day)	File size (MB)
2014-05-07	ALS_L1B_20140507T150530_154113	54330	56473	695.1
2014-05-07	ALS_L1B_20140507T154145_162839	56505	59319	912.6
2014-05-07	ALS_L1B_20140507T162856_165506	59336	60906	508.9
2014-05-07	ALS_L1B_20140507T165529_175223	60929	64343	1.107.2
2014-05-07	ALS_L1B_20140507T175243_191311	64363	69191	1.565.9
2014-05-08	ALS_L1B_20140508T130113_131851	46873	47931	329.2
2014-05-08	ALS_L1B_20140508T133359_141926	48839	51566	882.8
2014-05-08	ALS_L1B_20140508T141949_151549	51589	54949	1.089.6
2014-05-08	ALS_L1B_20140508T151630_155712	54990	57432	789.2
2014-05-08	ALS_L1B_20140508T160914_165629	58154	60989	918.7
2014-05-09	ALS_L1B_20140509T115240_124619	42760	45979	1.044.1
2014-05-09	ALS_L1B_20140509T124645_133955	46005	49195	1.034.5
2014-05-09	ALS_L1B_20140509T134030_143105	49230	52265	984.3
2014-05-09	ALS_L1B_20140509T143130_145926	52290	53966	543.5

11 APPENDIX Time-tagged and geo-located images

Time Tagged and geo-located images, GoPro

ASCII file	Date of acquisition	File name of zipped images	File size (MB)
PIX_GoPro_20140321.pos	21-03-2014	PIX_GoPro_20140321-143140.zip	1,333
		PIX_GoPro_20140321-150000.zip	3,037
		PIX_GoPro_20140321-160000.zip	2,584
		PIX_GoPro_20140321-170000.zip	2,582
		PIX_GoPro_20140321-180000.zip	2,623
		PIX_GoPro_20140321-190000.zip	3,027
		PIX_GoPro_20140321-200000.zip	1,949
PIX_GoPro_20140323a.pos	23-03-2014	PIX_GoPro_20140323-142648.zip	1,492
		PIX_GoPro_20140323-150007.zip	1,537
		PIX_GoPro_20140323-153325.zip	1,460
		PIX_GoPro_20140323-160642.zip	1,436
		PIX_GoPro_20140323-164001.zip	1,437
		PIX_GoPro_20140323-171319.zip	1,433
		PIX_GoPro_20140323-174637.zip	1,527
		PIX_GoPro_20140323-181955.zip	1,529
		PIX_GoPro_20140323-185313.zip	44
PIX_GoPro_20140323b.pos	23-03-2014	PIX_GoPro_20140323-202601.zip	1,530
		PIX_GoPro_20140323-205919.zip	1,495
		PIX_GoPro_20140323-213237.zip	1,567
		PIX_GoPro_20140323-220555.zip	1,538
		PIX_GoPro_20140323-223913.zip	1,536
		PIX_GoPro_20140323-231231.zip	1,412
		PIX_GoPro_20140323-234549.zip	1,452
		PIX_GoPro_20140323-001907.zip	464
PIX_GoPro_20140326.pos	26-03-2014	PIX_GoPro_20140326-140517.zip	1,429
		PIX_GoPro_20140326-143731.zip	1,460
		PIX_GoPro_20140326-151049.zip	1,214
		PIX_GoPro_20140326-153045.zip	1,506
		PIX_GoPro_20140326-160403.zip	1,532
		PIX_GoPro_20140326-163721.zip	1,411
		PIX_GoPro_20140326-171039.zip	1,467
		PIX_GoPro_20140326-174357.zip	1,653
		PIX_GoPro_20140326-181657.zip	1,961
		PIX_GoPro_20140326-185033.zip	1,719
		PIX_GoPro_20140326-192351.zip	1,324
PIX_GoPro_20140328.pos	28-03-2014	PIX_GoPro_20140328-143946.zip	2,022
		PIX_GoPro_20140328-144731.zip	517
		PIX_GoPro_20140328-145704.zip	1,706
		PIX_GoPro_20140328-153021.zip	1,898
		PIX_GoPro_20140328-160340.zip	1,619

Continued on next page

ASCII file	Date of acquisition	File name of zipped images	File size (MB)
PIX_GoPro_20140328.pos	28-03-2014	PIX_GoPro_20140328-163657.zip	1,501
		PIX_GoPro_20140328-171015.zip	1,595
		PIX_GoPro_20140328-174332.zip	713
		PIX_GoPro_20140328-181651.zip	1,516
		PIX_GoPro_20140328-185008.zip	1,569
		PIX_GoPro_20140328-192327.zip	1,775
PIX_GoPro_20140330.pos	30-03-2014	PIX_GoPro_20140330-123109.zip	159
		PIX_GoPro_20140330-130427.zip	2,324
		PIX_GoPro_20140330-133803.zip	2,288
		PIX_GoPro_20140330-141121.zip	2,225
		PIX_GoPro_20140330-144440.zip	2,203
		PIX_GoPro_20140330-151758.zip	2,209
		PIX_GoPro_20140330-155116.zip	1,626
PIX_GoPro_20140401.pos	01-04-2014	PIX_GoPro_20140401-094154.zip	1,451
		PIX_GoPro_20140401-101458.zip	1,651
		PIX_GoPro_20140401-104816.zip	1,836
		PIX_GoPro_20140401-112134.zip	1,774
		PIX_GoPro_20140401-115448.zip	1,678
		PIX_GoPro_20140401-122806.zip	1,488
		PIX_GoPro_20140401-130124.zip	1,568
		PIX_GoPro_20140401-133442.zip	1,626
		PIX_GoPro_20140401-140800.zip	1,840
		PIX_GoPro_20140401-144119.zip	1,591
		PIX_GoPro_20140401-151435.zip	278
PIX_GoPro_20140428.pos	28-04-2014	PIX_GoPro_20140428-114042.zip	1,863
		PIX_GoPro_20140428-121332.zip	1,805
PIX_GoPro_20140429.pos	29-04-2014	PIX_GoPro_20140429-094323.zip	1,949
		PIX_GoPro_20140429-101641.zip	1,620
		PIX_GoPro_20140429-104959.zip	1,787
		PIX_GoPro_20140429-112317.zip	1,735
		PIX_GoPro_20140429-115635.zip	2,122
		PIX_GoPro_20140429-122953.zip	349
PIX_GoPro_20140502.pos	02-05-2014	PIX_GoPro_20140502-095420.zip	1,928
		PIX_GoPro_20140502-102739.zip	1,461
		PIX_GoPro_20140502-110057.zip	808
		PIX_GoPro_20140502-111908.zip	1,449
		PIX_GoPro_20140502-115226.zip	1,447
		PIX_GoPro_20140502-122544.zip	1,467
		PIX_GoPro_20140502-125902.zip	1,559
PIX_GoPro_20140503a.pos	03-05-2014	PIX_GoPro_20140503-082115.zip	1,637
		PIX_GoPro_20140503-085433.zip	1,477
		PIX_GoPro_20140503-092751.zip	1,408
		PIX_GoPro_20140503-100109.zip	1,449
		PIX_GoPro_20140503-103427.zip	1,441
		PIX_GoPro_20140503-110745.zip	1,454

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ASCII file	Date of acquisition	File name of zipped images	File size (MB)
PIX_GoPro_20140503a.pos	03-05-2014	PIX_GoPro_20140503-114103.zip	137
		PIX_GoPro_20140503-114412.zip	1,566
		PIX_GoPro_20140503-121730.zip	1,572
PIX_GoPro_20140503b.pos	03-05-2014	PIX_GoPro_20140503-144158.zip	1,551
		PIX_GoPro_20140503-151516.zip	1,423
		PIX_GoPro_20140503-154834.zip	1,422
		PIX_GoPro_20140503-162152.zip	1,419
		PIX_GoPro_20140503-165510.zip	1,457
		PIX_GoPro_20140503-172828.zip	854
PIX_GoPro_20140505.pos	05-05-2014	PIX_GoPro_20140505-094431.zip	1,491
		PIX_GoPro_20140505-101749.zip	1,528
		PIX_GoPro_20140505-105107.zip	597
		PIX_GoPro_20140505-110454.zip	1,546
		PIX_GoPro_20140505-113812.zip	1,467
		PIX_GoPro_20140505-121130.zip	1,460
		PIX_GoPro_20140505-124448.zip	1,368
PIX_GoPro_20140508.pos	08-05-2014	PIX_GoPro_20140508-122044.zip	2,070
		PIX_GoPro_20140508-125402.zip	1,750
		PIX_GoPro_20140508-132720.zip	2,036
		PIX_GoPro_20140508-140038.zip	1,446
		PIX_GoPro_20140508-143356.zip	1,458
		PIX_GoPro_20140508-150714.zip	1,483
		PIX_GoPro_20140508-154032.zip	93
		PIX_GoPro_20140508-154240.zip	1,453
		PIX_GoPro_20140508-161559.zip	1,483
		PIX_GoPro_20140508-164917.zip	1,308
PIX_GoPro_20140509.pos	09-05-2014	PIX_GoPro_20140509-110121.zip	2,073
		PIX_GoPro_20140509-113432.zip	1,855
		PIX_GoPro_20140509-120751.zip	1,489
		PIX_GoPro_20140509-124109.zip	1,484
		PIX_GoPro_20140509-131427.zip	1,460
		PIX_GoPro_20140509-134746.zip	1,449
		PIX_GoPro_20140509-142104.zip	1,514
		PIX_GoPro_20140509-145421.zip	325
		PIX_GoPro_20140509-150123.zip	1,682
		PIX_GoPro_20140509-153440.zip	1,522

Time-tagged and geo-located images, uEye

ASCII file	Date of acquisition	File name of zipped images	File size (MB)
PIX_uEye_20140318.pos	18-03-2014	PIX_uEye_20140318-154527.zip	2,165
		PIX_uEye_20140318-160000.zip	9,251
		PIX_uEye_20140318-170000.zip	8,742
		PIX_uEye_20140318-181403.zip	6,140
		PIX_uEye_20140318-190000.zip	8,672
		PIX_uEye_20140318-200000.zip	586
PIX_uEye_20140321.pos	21-03-2014	PIX_uEye_20140321-145849.zip	4,243
		PIX_uEye_20140321-160000.zip	3,291
		PIX_uEye_20140321-170000.zip	4,073
		PIX_uEye_20140321-180000.zip	3,892
		PIX_uEye_20140321-190000.zip	4,534
		PIX_uEye_20140321-200000.zip	58
PIX_uEye_20140401.pos	01-04-2014	PIX_uEye_20140401-110908.zip	4,321
		PIX_uEye_20140401-120000.zip	2,430
		PIX_uEye_20140401-133059.zip	1,176
PIX_uEye_20140429.pos	29-04-2014	PIX_uEye_20140429-094237.zip	581
		PIX_uEye_20140429-100000.zip	3,369
		PIX_uEye_20140429-110000.zip	3,179
		PIX_uEye_20140429-120000.zip	1,648
PIX_uEye_20140502.pos	02-05-2014	PIX_uEye_20140502-095429.zip	84
		PIX_uEye_20140502-100000.zip	2,387
		PIX_uEye_20140502-110000.zip	2,229
		PIX_uEye_20140502-120000.zip	2,556
		PIX_uEye_20140502-130000.zip	979
PIX_uEye_20140503.pos	03-05-2014	PIX_uEye_20140503-082217.zip	2,002
		PIX_uEye_20140503-090000.zip	3,932
		PIX_uEye_20140503-100000.zip	4,189
		PIX_uEye_20140503-110000.zip	3,891
		PIX_uEye_20140503-120000.zip	4,252
PIX_uEye_20140505.pos	05-05-2014	PIX_uEye_20140505-094932.zip	793
		PIX_uEye_20140505-100000.zip	2,008
		PIX_uEye_20140505-110000.zip	4,053
		PIX_uEye_20140505-120000.zip	3,995
		PIX_uEye_20140505-130000.zip	2,430
		PIX_uEye_20140505-140000.zip	341
PIX_uEye_20140506.pos	06-05-2014	PIX_uEye_20140506-122742.zip	1,836
		PIX_uEye_20140506-130000.zip	2,616
		PIX_uEye_20140506-140000.zip	3,055
		PIX_uEye_20140506-150000.zip	2,860
		PIX_uEye_20140506-170000.zip	1,246

Continued on next page

ASCII file	Date of acquisition	File name of zipped images	File size (MB)
PIX_uEye_20140507.pos	07-05-2014	PIX_uEye_20140507-141223.zip	2,099
		PIX_uEye_20140507-150000.zip	2,668
		PIX_uEye_20140507-160000.zip	3,691
		PIX_uEye_20140507-170000.zip	4,035
		PIX_uEye_20140507-180000.zip	4,042
		PIX_uEye_20140507-190000.zip	3,337
PIX_uEye_20140508.pos	08-05-2014	PIX_uEye_20140508-122107.zip	2,604
		PIX_uEye_20140508-130000.zip	3,741
		PIX_uEye_20140508-140000.zip	2,636
		PIX_uEye_20140508-150000.zip	3,696
		PIX_uEye_20140508-160000.zip	4,278
		PIX_uEye_20140508-170000.zip	1,085

12 APPENDIX Processed ASIRAS profiles

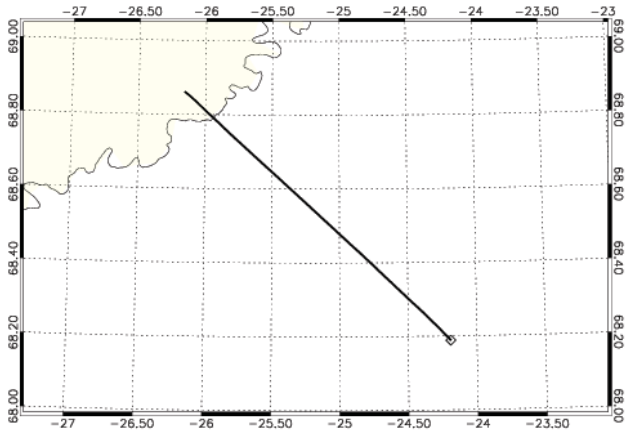
Following plots show all processed ASIRAS profiles. Each profile are plotted twice, and are shown next to each other using either the OCOG (left) or the TSRA (right) re-tracker. Each profile plot consists of four parts:

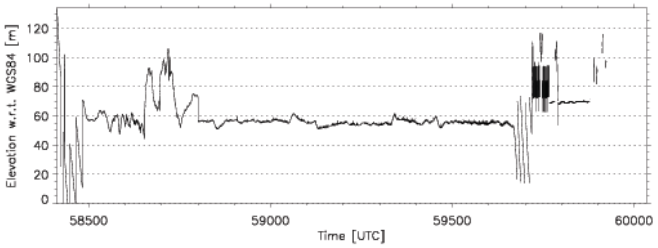
1. Header composed of daily profile number and the date and a sub-header with the filename.
2. Geographical plot of the profile (diamond indicates the start of the profile).
3. Rough indication of the heights as determined with the OCOG or TSRA retracker plotted versus time of day in seconds.
4. Info box with date, start and stop times in hour, minute, seconds, and in square brackets seconds of the day, acquisition mode etc.

It should be emphasized that the surface height determined by the OCOG retracker is a rough estimate and not a true height.

A140317_00

AS30A00_ASWL1B0403201403171161331_20140317164406_0001.DBL

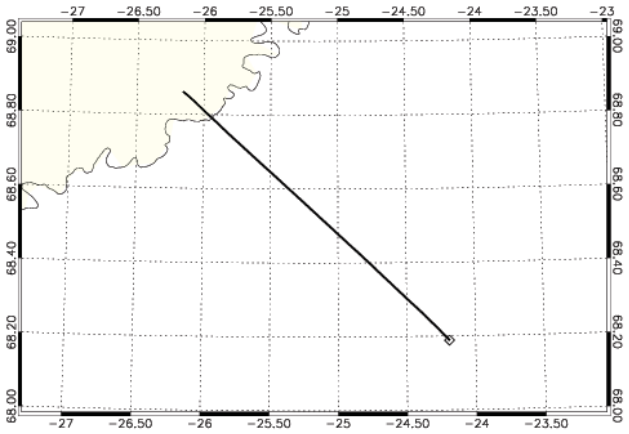


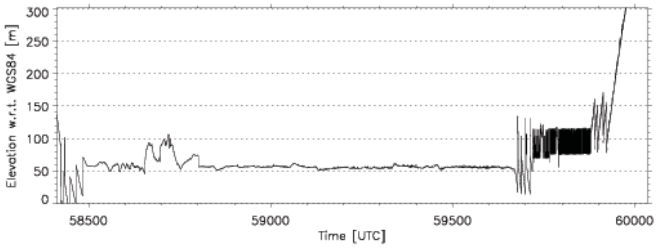


Date	2014−03−17	**Instrument Mode**	Adv. Low Altitude
Start Time	16:13:31 (58411)	**Aircraft**	DNSC Twin Otter
Stop Time	16:40:35 (60035)	**Retracker**	OCOG
Distance	109.549 km	**INS Resolution**	50 Hz
Duration	00 h 27 m 04 s	**Processor Version**	0403

A140317_00

AS30A00_ASWL1B0403201403171161331_20140317164406_0001.DBL

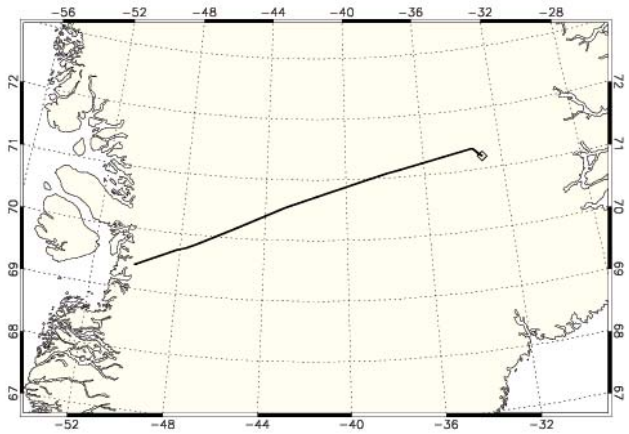


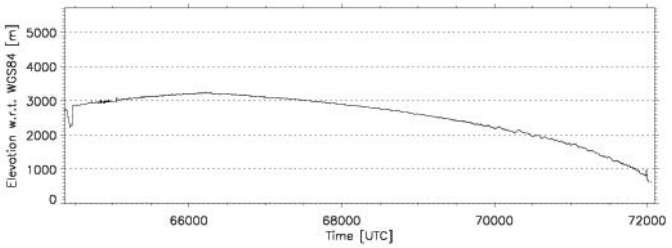


Date	2014−03−17	**Instrument Mode**	Adv. Low Altitude
Start Time	16:13:32 (58412)	**Aircraft**	DNSC Twin Otter
Stop Time	16:40:36 (60036)	**Retracker**	TSRA
Distance	109.551 km	**INS Resolution**	50 Hz
Duration	00 h 27 m 04 s	**Processor Version**	0403

A140317_01

AS30A01_ASWL1B0403201403171175250_20140317200458_0001.DBL

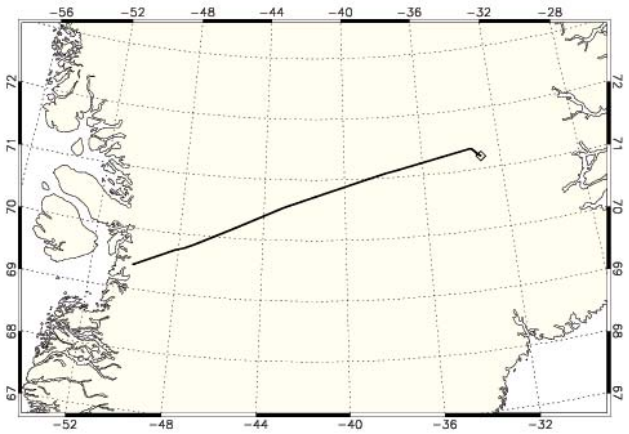


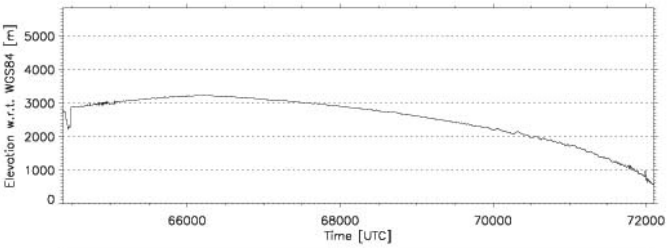


Date	2014−03−17	**Instrument Mode**	Adv. Low Altitude
Start Time	17:52:50 (64370)	**Aircraft**	DNSC Twin Otter
Stop Time	20:01:42 (72102)	**Retracker**	OCOG
Distance	677.259 km	**INS Resolution**	50 Hz
Duration	02 h 08 m 52 s	**Processor Version**	0403

A140317_01

AS30A01_ASWL1B0403201403171175250_20140317200458_0001.DBL

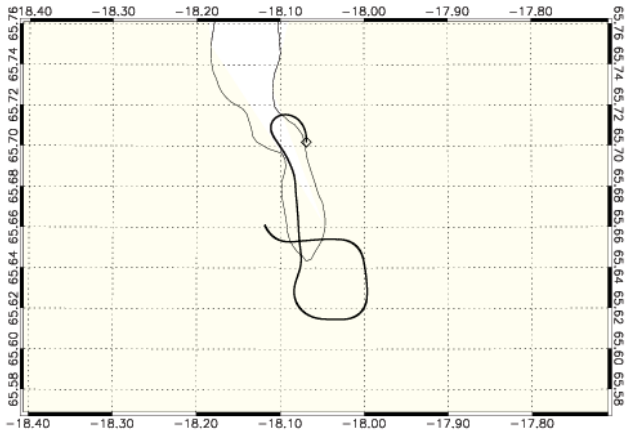


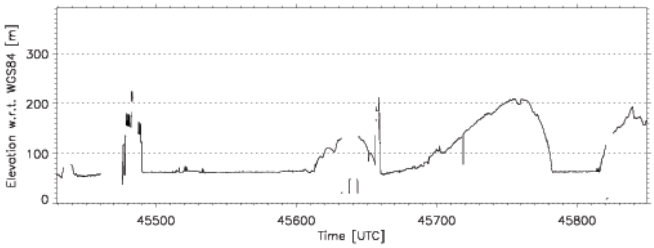


Date	2014−03−17	**Instrument Mode**	Adv. Low Altitude
Start Time	17:52:51 (64371)	**Aircraft**	DNSC Twin Otter
Stop Time	20:01:43 (72103)	**Retracker**	TSRA
Distance	676.647 km	**INS Resolution**	50 Hz
Duration	02 h 08 m 52 s	**Processor Version**	0403

A140317_02

AS30A02_ASWL1B0403201403171123709_20140317T124410_0001.DBL

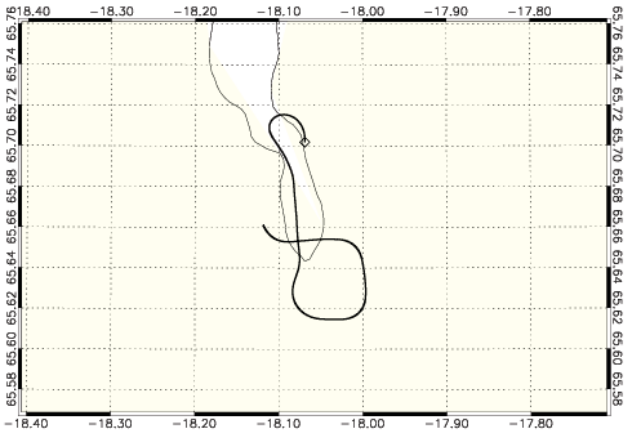


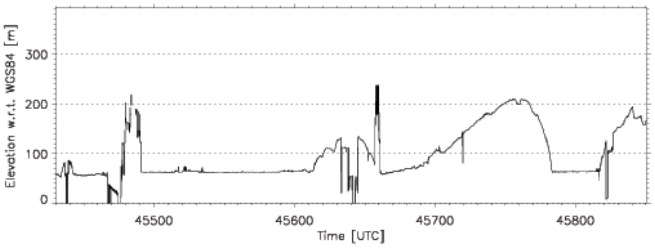


Date	2014−03−17	**Instrument Mode**	Adv. Low Altitude
Start Time	12:37:09 (45429)	**Aircraft**	DNSC Twin Otter
Stop Time	12:44:09 (45849)	**Retracker**	OCOG
Distance	26.632 km	**INS Resolution**	50 Hz
Duration	00 h 07 m 01 s	**Processor Version**	0403

A140317_02

AS30A02_ASWL1B0403201403171123709_20140317T124410_0001.DBL

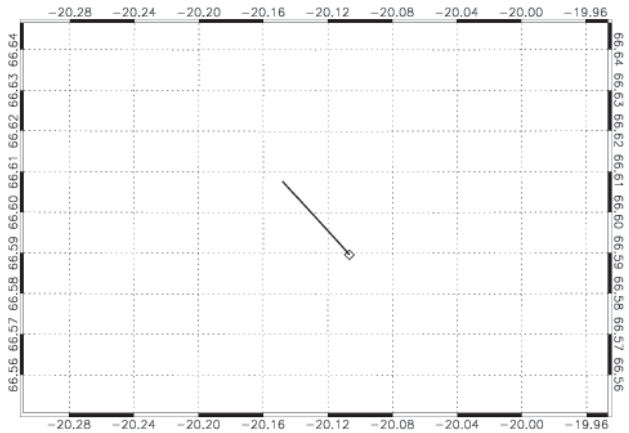


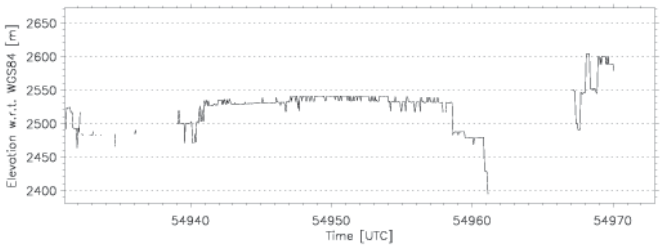


Date	2014−03−17	**Instrument Mode**	Adv. Low Altitude
Start Time	12:37:10 (45430)	**Aircraft**	DNSC Twin Otter
Stop Time	12:44:10 (45850)	**Retracker**	TSRA
Distance	26.632 km	**INS Resolution**	50 Hz
Duration	00 h 07 m 01 s	**Processor Version**	0403

A140317_03

AS30A03_ASWL1B0403201403171151531_20140317T151613_0001.DBL

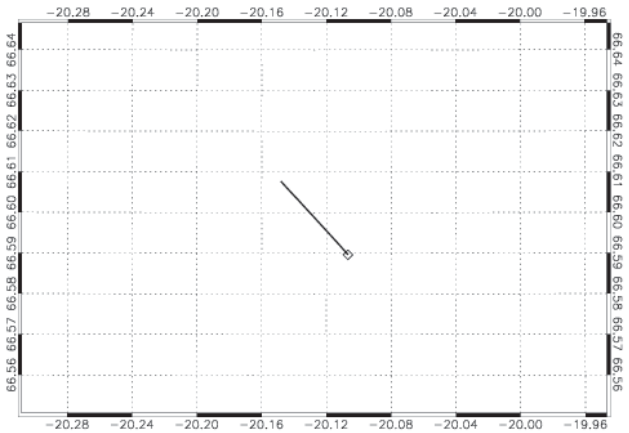


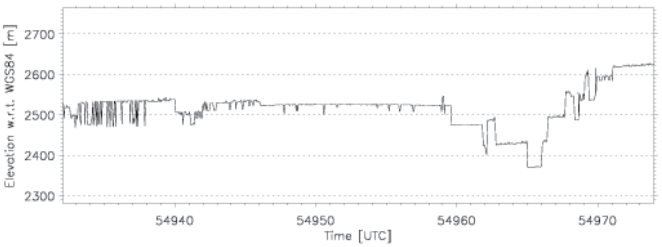


Date	2014−03−17	**Instrument Mode**	Adv. Low Altitude
Start Time	15:15:31 (54931)	**Aircraft**	DNSC Twin Otter
Stop Time	15:16:12 (54972)	**Retracker**	OCOG
Distance	2.720 km	**INS Resolution**	50 Hz
Duration	00 h 00 m 42 s	**Processor Version**	0403

A140317_03

AS30A03_ASWL1B0403201403171151531_20140317T151613_0001.DBL

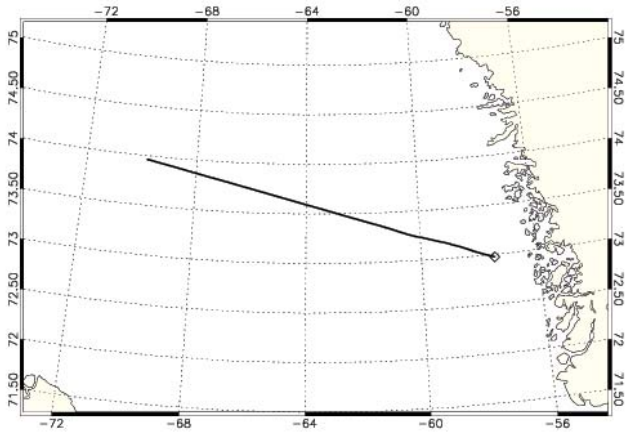


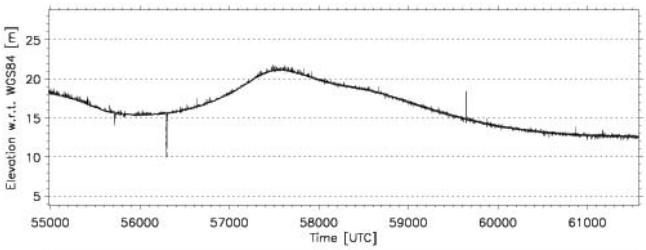


Date	2014−03−17	**Instrument Mode**	Adv. Low Altitude
Start Time	15:15:32 (54932)	**Aircraft**	DNSC Twin Otter
Stop Time	15:16:13 (54973)	**Retracker**	TSRA
Distance	2.720 km	**INS Resolution**	50 Hz
Duration	00 h 00 m 42 s	**Processor Version**	0403

A140318_00

AS3OA00_ASIWL1B0403201403181T151618_20140318T170615_0001.DBL

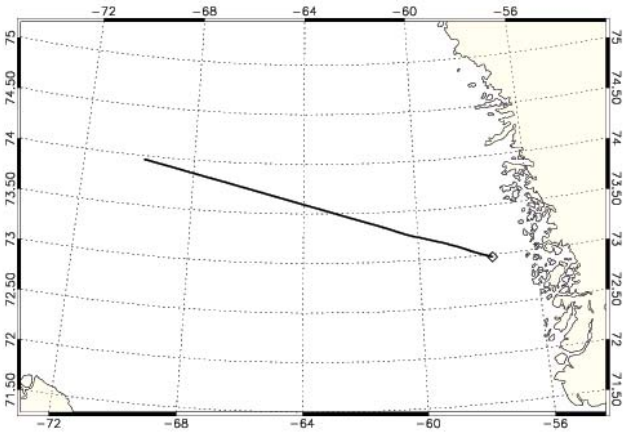


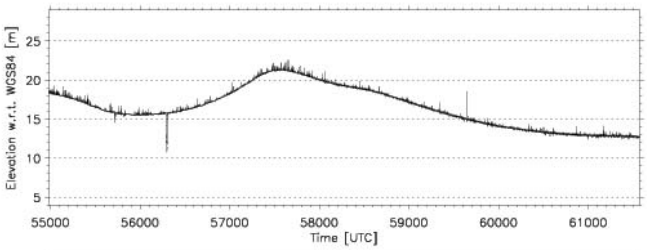


Date	2014−03−18	**Instrument Mode**	Adv. Low Altitude
Start Time	15:16:18 (54978)	**Aircraft**	DNSC Twin Otter
Stop Time	17:06:14 (61574)	**Retracker**	OCOG
Distance	404.604 km	**INS Resolution**	50 Hz
Duration	01 h 49 m 57 s	**Processor Version**	0403

A140318_00

AS3OA00_ASIWL1B0403201403181T151618_20140318T170615_0001.DBL

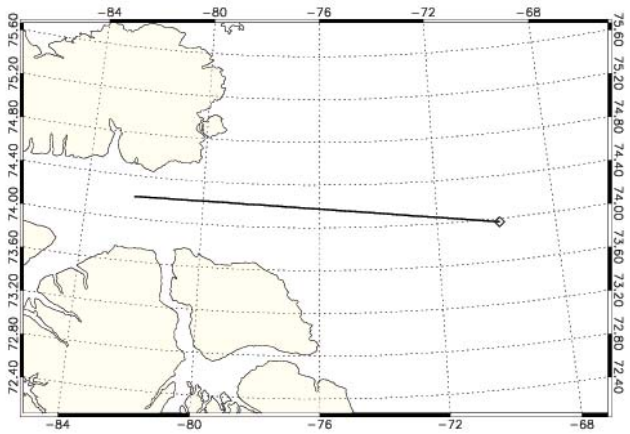


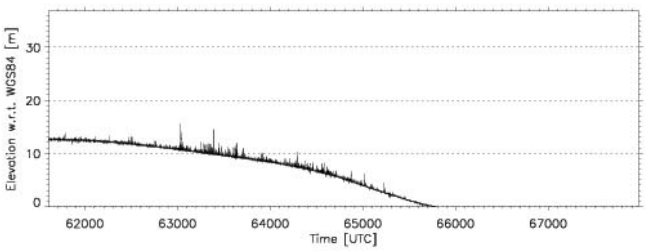


Date	2014−03−18	**Instrument Mode**	Adv. Low Altitude
Start Time	15:16:19 (54979)	**Aircraft**	DNSC Twin Otter
Stop Time	17:06:15 (61575)	**Retracker**	TSRA
Distance	404.522 km	**INS Resolution**	50 Hz
Duration	01 h 49 m 57 s	**Processor Version**	0403

A140318_01

AS3OA01_ASIWL1B0403201403181T170647_20140318T185258_0001.DBL

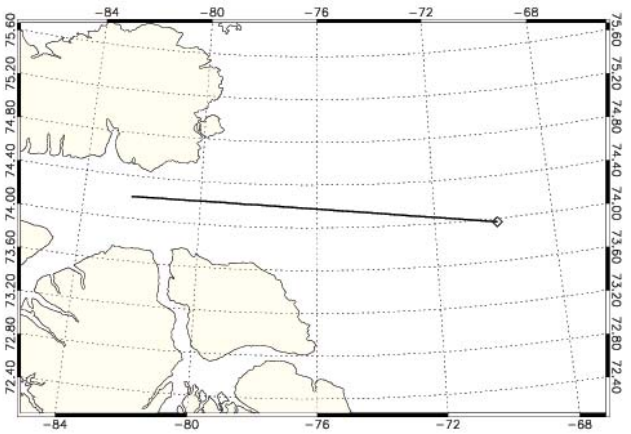


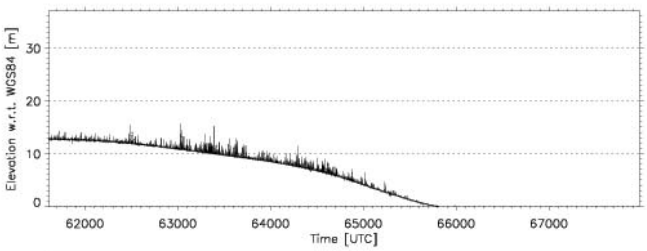


Date	2014−03−18	**Instrument Mode**	Adv. Low Altitude
Start Time	17:06:47 (61607)	**Aircraft**	DNSC Twin Otter
Stop Time	18:52:57 (67977)	**Retracker**	OCOG
Distance	379.392 km	**INS Resolution**	50 Hz
Duration	01 h 46 m 11 s	**Processor Version**	0403

A140318_01

AS3OA01_ASIWL1B0403201403181T170647_20140318T185258_0001.DBL

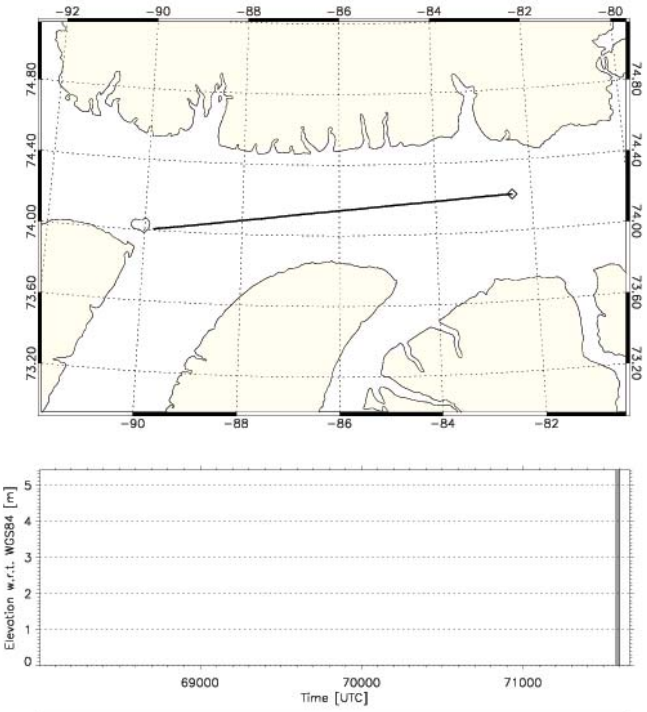




Date	2014−03−18	**Instrument Mode**	Adv. Low Altitude
Start Time	17:06:48 (61608)	**Aircraft**	DNSC Twin Otter
Stop Time	18:52:58 (67978)	**Retracker**	TSRA
Distance	379.385 km	**INS Resolution**	50 Hz
Duration	01 h 46 m 11 s	**Processor Version**	0403

A140318_02

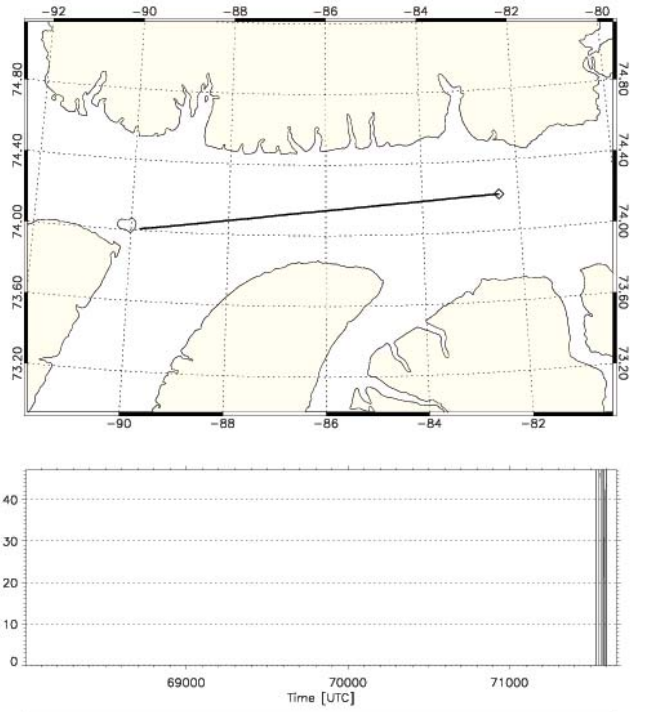
AS3OA02_ASWL1B040320140318T185325_20140318T195423_0001.DBL



Date	2014−03−18	**Instrument Mode**	Adv. Low Altitude
Start Time	18:53:25 (68005)	**Aircraft**	DNSC Twin Otter
Stop Time	19:54:22 (71662)	**Retracker**	OCOG
Distance	226.288 km	**INS Resolution**	50 Hz
Duration	01 h 00 m 58 s	**Processor Version**	0403

A140318_02

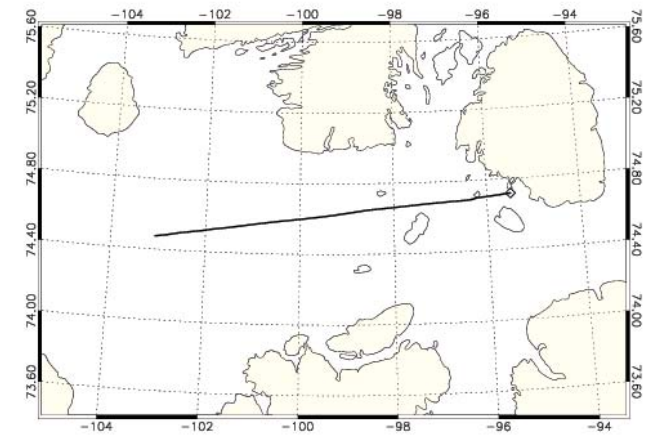
AS3OA02_ASWL1B040320140318T185325_20140318T195423_0001.DBL

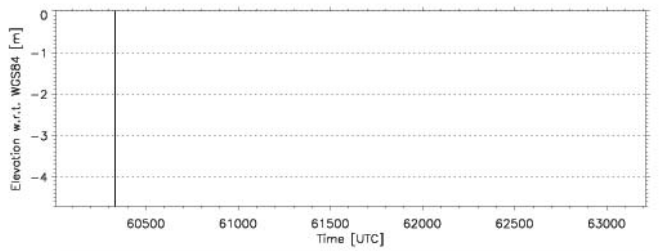


Date	2014−03−18	**Instrument Mode**	Adv. Low Altitude
Start Time	18:53:26 (68006)	**Aircraft**	DNSC Twin Otter
Stop Time	19:54:23 (71663)	**Retracker**	TSRA
Distance	226.286 km	**INS Resolution**	50 Hz
Duration	01 h 00 m 58 s	**Processor Version**	0403

A140319_00

AS3OA00_ASWL1B040320140319T164009_20140319T173333_0001.DBL

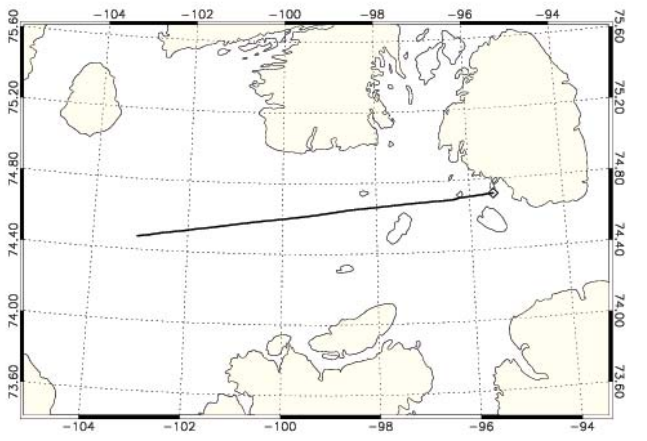


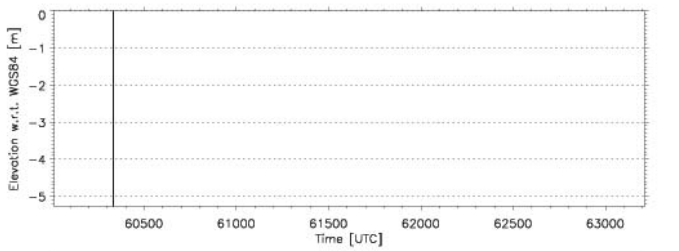


Date	2014−03−19	**Instrument Mode**	Adv. Low Altitude
Start Time	16:40:09 (60009)	**Aircraft**	DNSC Twin Otter
Stop Time	17:33:32 (63212)	**Retracker**	OCOG
Distance	225.506 km	**INS Resolution**	50 Hz
Duration	00 h 53 m 24 s	**Processor Version**	0403

A140319_00

AS3OA00_ASWL1B040320140319T164009_20140319T173333_0001.DBL

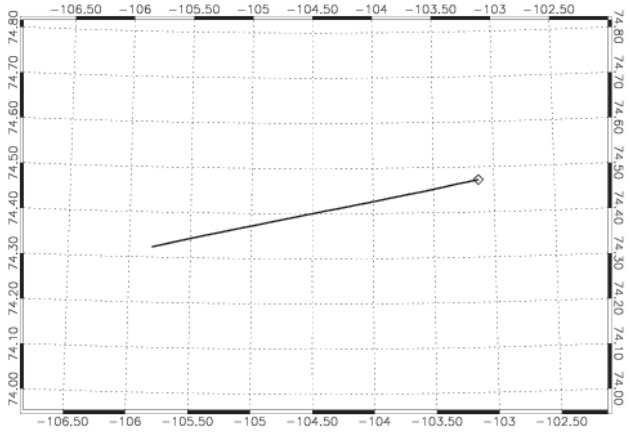


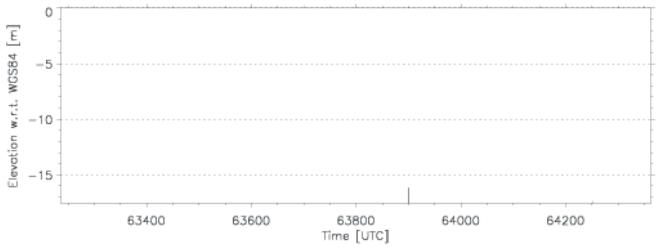


Date	2014−03−19	**Instrument Mode**	Adv. Low Altitude
Start Time	16:40:10 (60010)	**Aircraft**	DNSC Twin Otter
Stop Time	17:33:33 (63213)	**Retracker**	TSRA
Distance	225.506 km	**INS Resolution**	50 Hz
Duration	00 h 53 m 24 s	**Processor Version**	0403

A140319_01

AS30A01_ASWL180403201403191173356_20140319T190221_0001.DBL

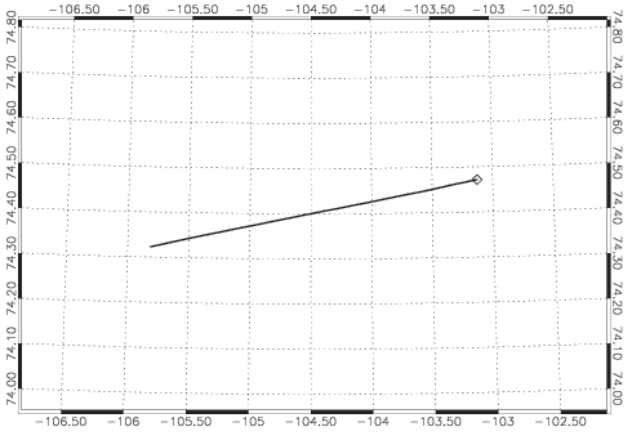


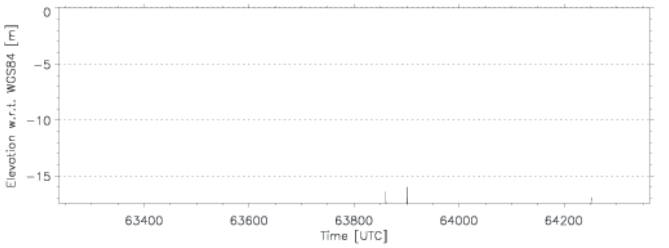


Date	2014−03−19	**Instrument Mode**	Adv. Low Altitude
Start Time	17:33:56 (63236)	**Aircraft**	DNSC Twin Otter
Stop Time	17:52:42 (64362)	**Retracker**	OCOG
Distance	81.944 km	**INS Resolution**	50 Hz
Duration	00 h 18 m 47 s	**Processor Version**	0403

A140319_01

AS30A01_ASWL180403201403191173356_20140319T190221_0001.DBL

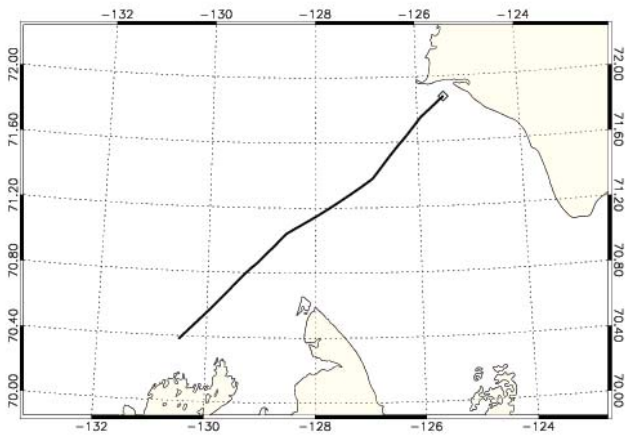


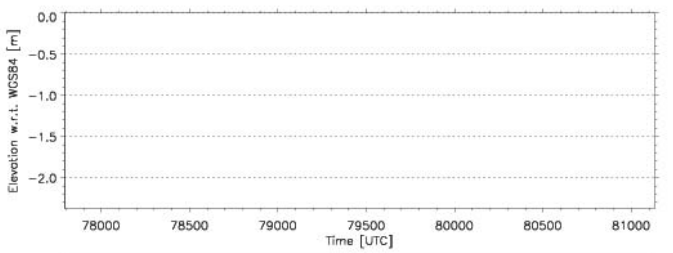


Date	2014−03−19	**Instrument Mode**	Adv. Low Altitude
Start Time	17:33:57 (63237)	**Aircraft**	DNSC Twin Otter
Stop Time	17:52:43 (64363)	**Retracker**	TSRA
Distance	81.943 km	**INS Resolution**	50 Hz
Duration	00 h 18 m 47 s	**Processor Version**	0403

A140319_02

AS30A02_ASWL180403201403191213633_20140319T223214_0001.DBL

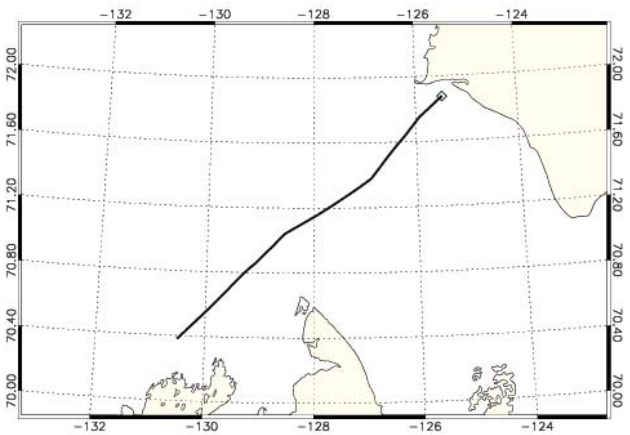


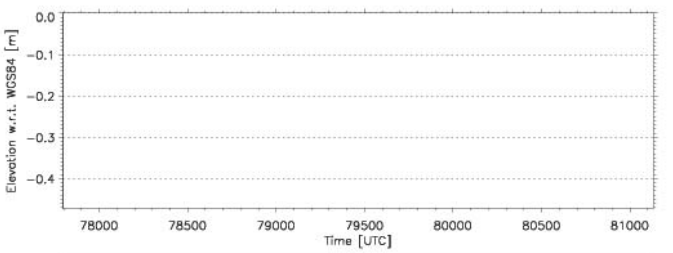


Date	2014−03−19	**Instrument Mode**	Adv. Low Altitude
Start Time	21:36:33 (77793)	**Aircraft**	DNSC Twin Otter
Stop Time	22:32:13 (81133)	**Retracker**	OCOG
Distance	247.029 km	**INS Resolution**	50 Hz
Duration	00 h 55 m 41 s	**Processor Version**	0403

A140319_02

AS30A02_ASWL180403201403191213633_20140319T223214_0001.DBL

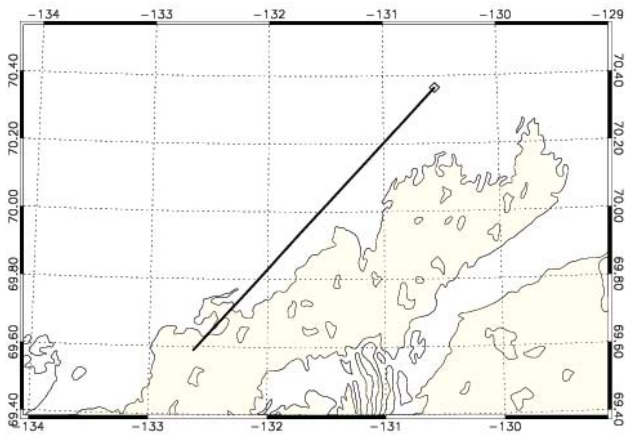


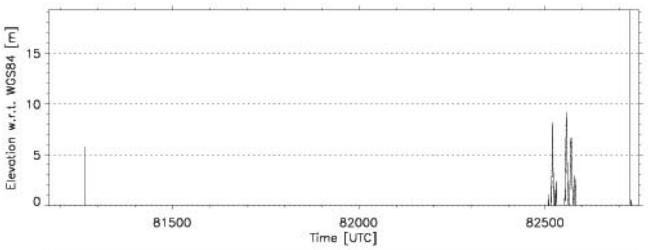


Date	2014−03−19	**Instrument Mode**	Adv. Low Altitude
Start Time	21:36:34 (77794)	**Aircraft**	DNSC Twin Otter
Stop Time	22:32:14 (81134)	**Retracker**	TSRA
Distance	246.947 km	**INS Resolution**	50 Hz
Duration	00 h 55 m 41 s	**Processor Version**	0403

A140319_03

AS30A03_ASWL180403201403191223248_20140319T225912_0001.DBL

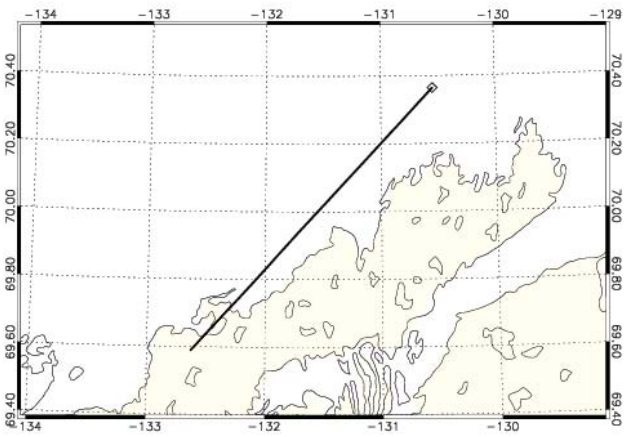


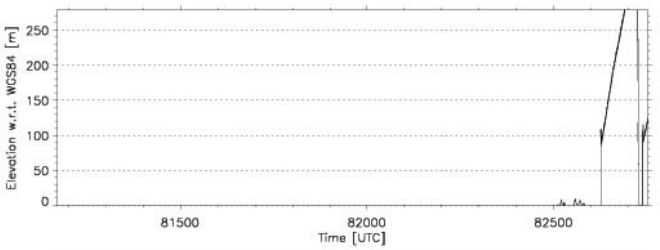


Date	2014−03−19	**Instrument Mode**	Adv. Low Altitude
Start Time	22:32:48 (81168)	**Aircraft**	DNSC Twin Otter
Stop Time	22:59:11 (82751)	**Retracker**	OCOG
Distance	117.106 km	**INS Resolution**	50 Hz
Duration	00 h 26 m 23 s	**Processor Version**	0403

A140319_03

AS30A03_ASWL180403201403191223248_20140319T225912_0001.DBL

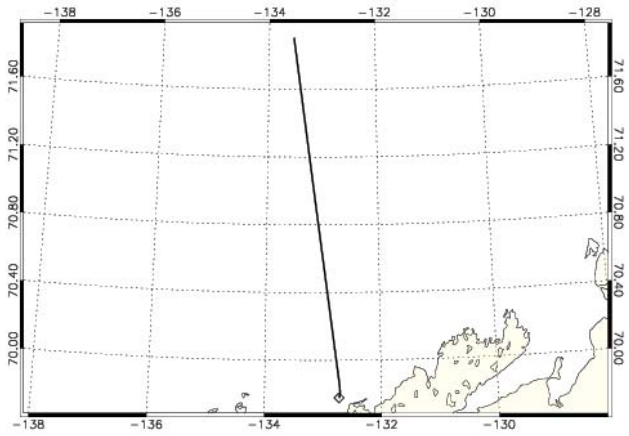


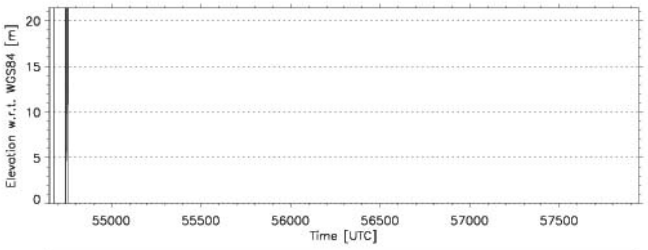


Date	2014−03−19	**Instrument Mode**	Adv. Low Altitude
Start Time	22:32:49 (81169)	**Aircraft**	DNSC Twin Otter
Stop Time	22:59:12 (82752)	**Retracker**	TSRA
Distance	117.101 km	**INS Resolution**	50 Hz
Duration	00 h 26 m 23 s	**Processor Version**	0403

A140321_01

AS30A01_ASWL180403201403211151049_20140321T160545_0001.DBL

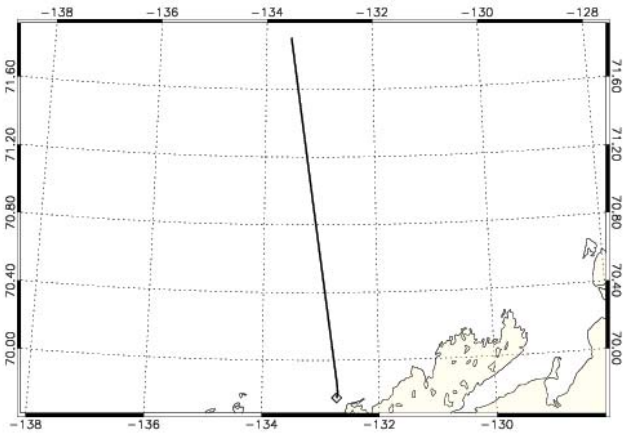


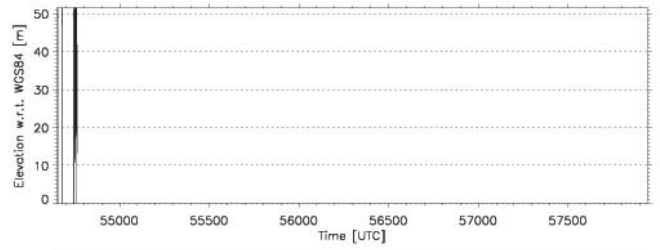


Date	2014−03−21	**Instrument Mode**	Adv. Low Altitude
Start Time	15:10:49 (54649)	**Aircraft**	DNSC Twin Otter
Stop Time	16:05:44 (57944)	**Retracker**	OCOG
Distance	237.933 km	**INS Resolution**	50 Hz
Duration	00 h 54 m 56 s	**Processor Version**	0403

A140321_01

AS30A01_ASWL180403201403211151049_20140321T160545_0001.DBL

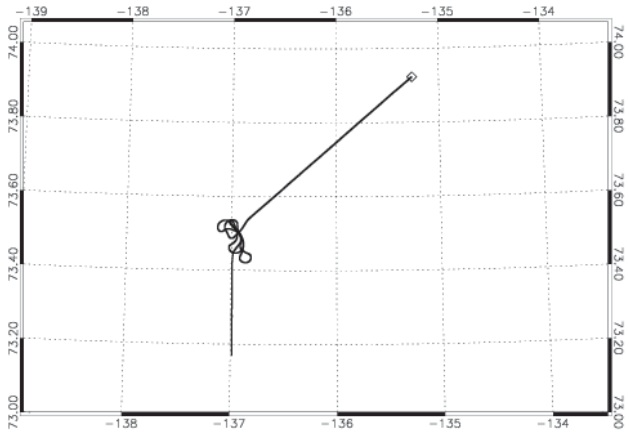


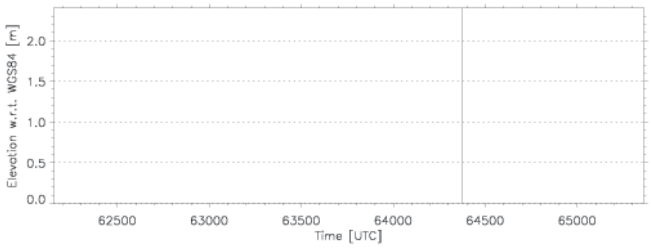


Date	2014−03−21	**Instrument Mode**	Adv. Low Altitude
Start Time	15:10:50 (54650)	**Aircraft**	DNSC Twin Otter
Stop Time	16:05:45 (57945)	**Retracker**	TSRA
Distance	237.700 km	**INS Resolution**	50 Hz
Duration	00 h 54 m 56 s	**Processor Version**	0403

A140321_03

AS30A03_ASWL1B0403201403211171553_20140321T180923_0001.DBL

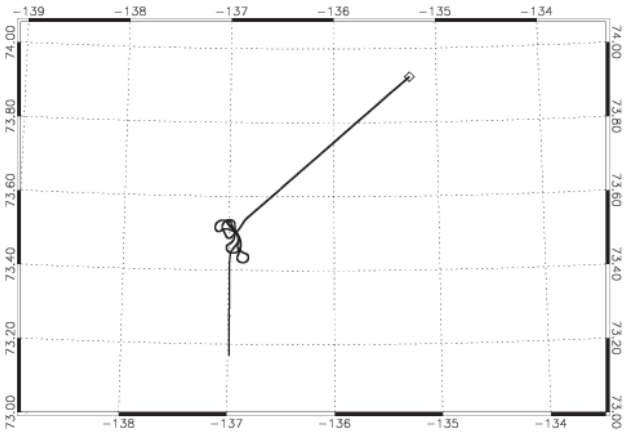


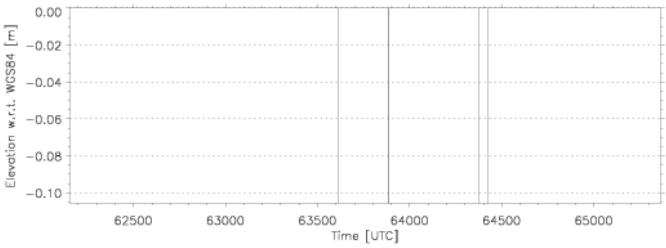


Date	2014-03-21	**Instrument Mode**	Adv. Low Altitude
Start Time	17:15:53 (62153)	**Aircraft**	DNSC Twin Otter
Stop Time	18:09:22 (65362)	**Retracker**	OCOG
Distance	187.590 km	**INS Resolution**	50 Hz
Duration	00 h 53 m 30 s	**Processor Version**	0403

A140321_03

AS30A03_ASWL1B0403201403211171553_20140321T180923_0001.DBL

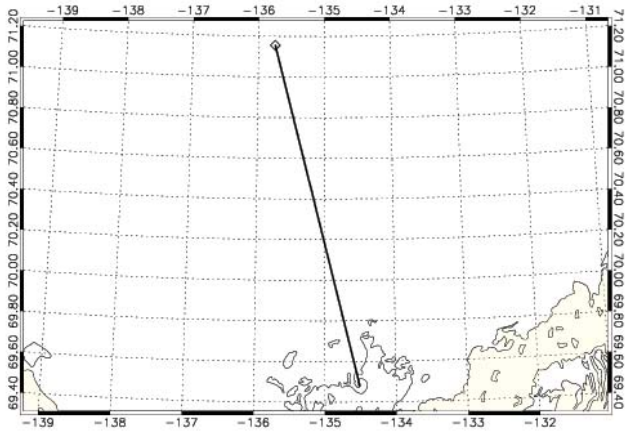


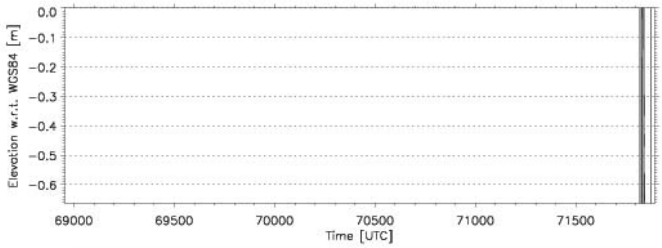


Date	2014-03-21	**Instrument Mode**	Adv. Low Altitude
Start Time	17:15:54 (62154)	**Aircraft**	DNSC Twin Otter
Stop Time	18:09:23 (65363)	**Retracker**	TSRA
Distance	187.578 km	**INS Resolution**	50 Hz
Duration	00 h 53 m 30 s	**Processor Version**	0403

A140321_05

AS30A05_ASWL1B0403201403211190913_20140321T195815_0001.DBL

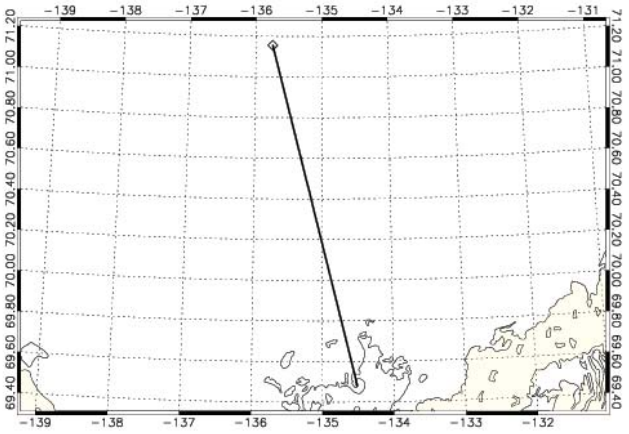


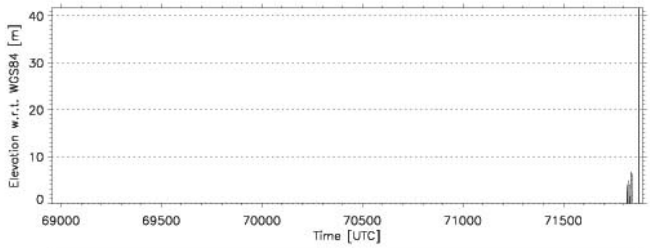


Date	2014-03-21	**Instrument Mode**	Adv. Low Altitude
Start Time	19:09:13 (68953)	**Aircraft**	DNSC Twin Otter
Stop Time	19:58:14 (71894)	**Retracker**	OCOG
Distance	192.024 km	**INS Resolution**	50 Hz
Duration	00 h 49 m 01 s	**Processor Version**	0403

A140321_05

AS30A05_ASWL1B0403201403211190913_20140321T195815_0001.DBL

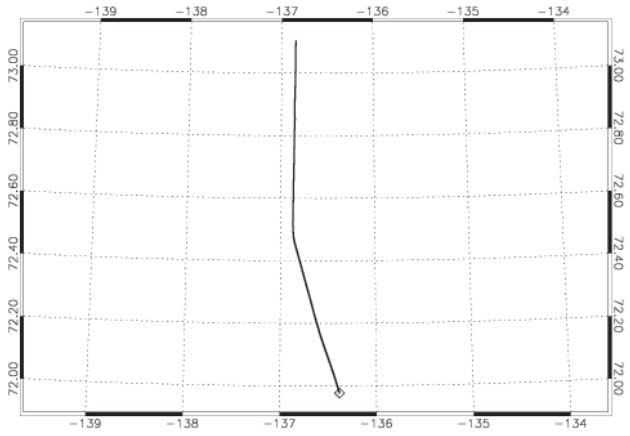


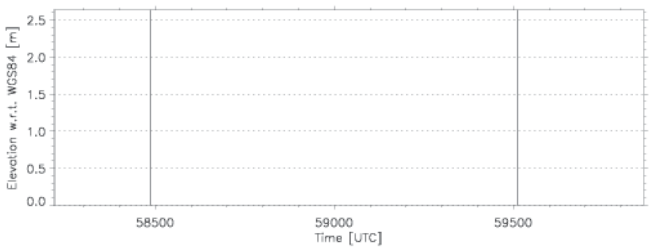


Date	2014-03-21	**Instrument Mode**	Adv. Low Altitude
Start Time	19:09:14 (68954)	**Aircraft**	DNSC Twin Otter
Stop Time	19:58:15 (71895)	**Retracker**	TSRA
Distance	191.928 km	**INS Resolution**	50 Hz
Duration	00 h 49 m 01 s	**Processor Version**	0403

A140323_03

AS30A03_ASWL18040320140323T161016_20140323T171327_0001.DBL

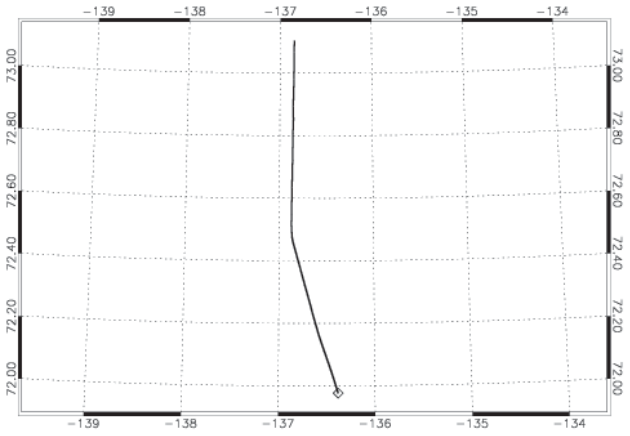


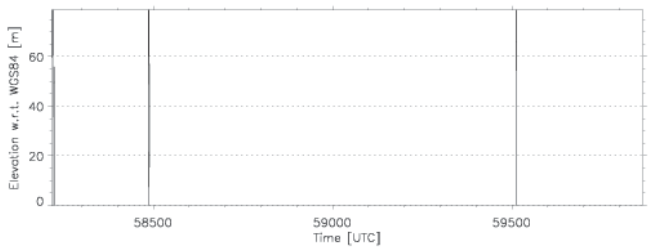


Date	2014-03-23	**Instrument Mode**	Adv. Low Altitude
Start Time	16:10:16 (58216)	**Aircraft**	DNSC Twin Otter
Stop Time	16:37:44 (59864)	**Retracker**	OCOG
Distance	127.794 km	**INS Resolution**	50 Hz
Duration	00 h 27 m 29 s	**Processor Version**	0403

A140323_03

AS30A03_ASWL18040320140323T161016_20140323T171327_0001.DBL

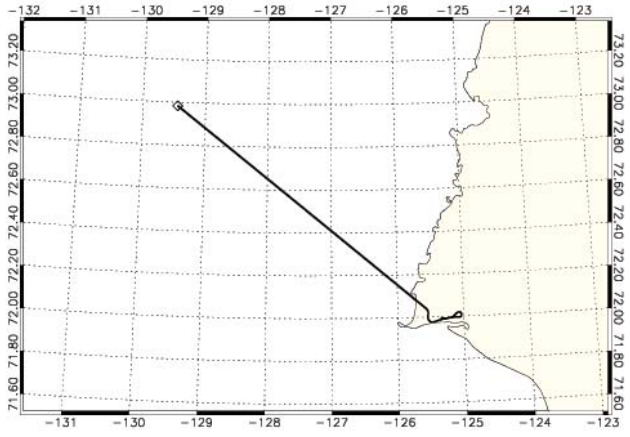


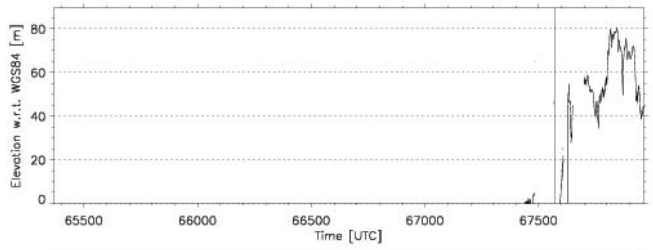


Date	2014-03-23	**Instrument Mode**	Adv. Low Altitude
Start Time	16:10:17 (58217)	**Aircraft**	DNSC Twin Otter
Stop Time	16:37:45 (59865)	**Retracker**	TSRA
Distance	127.829 km	**INS Resolution**	50 Hz
Duration	00 h 27 m 29 s	**Processor Version**	0403

A140323_05

AS30A05_ASWL18040320140323T180926_20140323T185244_0001.DBL

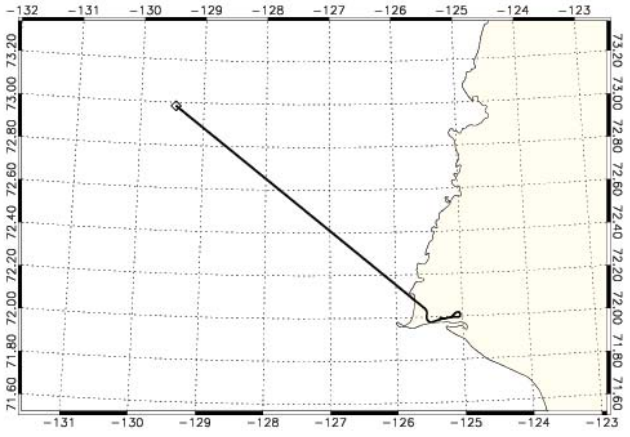


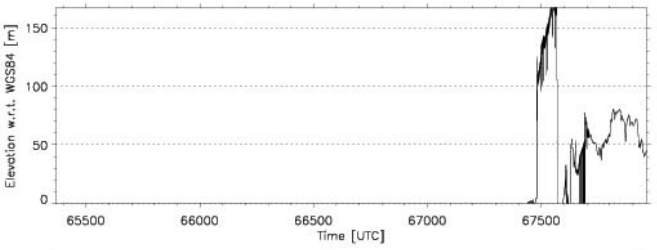


Date	2014-03-23	**Instrument Mode**	Adv. Low Altitude
Start Time	18:09:26 (65366)	**Aircraft**	DNSC Twin Otter
Stop Time	18:52:43 (67963)	**Retracker**	OCOG
Distance	204.194 km	**INS Resolution**	50 Hz
Duration	00 h 43 m 17 s	**Processor Version**	0403

A140323_05

AS30A05_ASWL18040320140323T180926_20140323T185244_0001.DBL

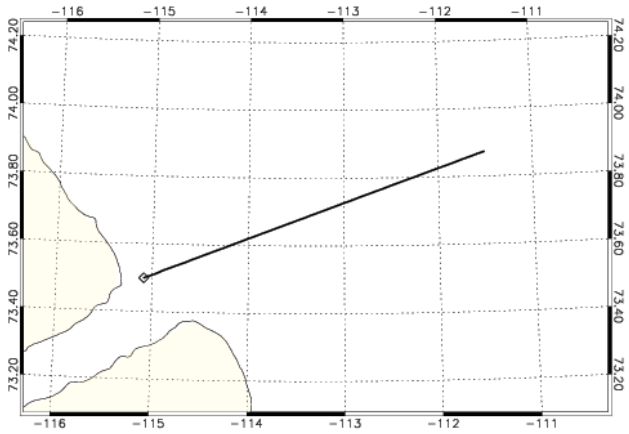


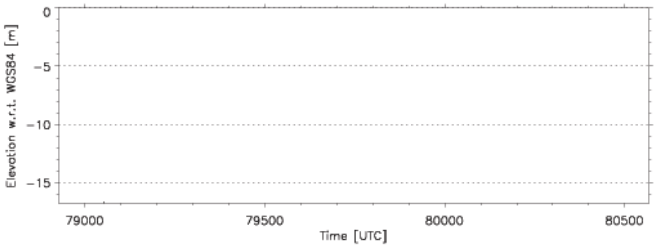


Date	2014-03-23	**Instrument Mode**	Adv. Low Altitude
Start Time	18:09:27 (65367)	**Aircraft**	DNSC Twin Otter
Stop Time	18:52:44 (67964)	**Retracker**	TSRA
Distance	204.251 km	**INS Resolution**	50 Hz
Duration	00 h 43 m 17 s	**Processor Version**	0403

A140323_06

AS30A06_ASWL1B0403201403231215527_20140323T222248_0001.DBL

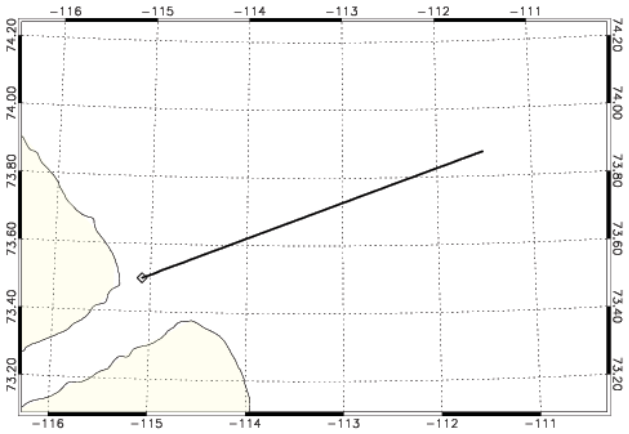


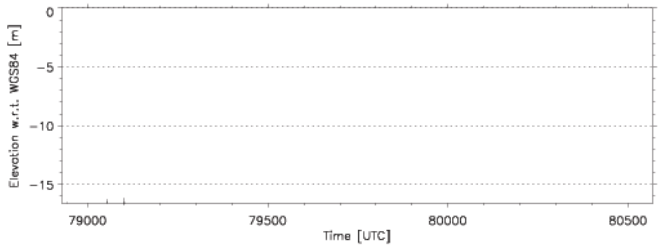


Date	2014−03−23	**Instrument Mode**	Adv. Low Altitude
Start Time	21:55:27 (78927)	**Aircraft**	DNSC Twin Otter
Stop Time	22:22:47 (80567)	**Retracker**	OCOG
Distance	119.012 km	**INS Resolution**	50 Hz
Duration	00 h 27 m 21 s	**Processor Version**	0403

A140323_06

AS30A06_ASWL1B0403201403231215527_20140323T222248_0001.DBL

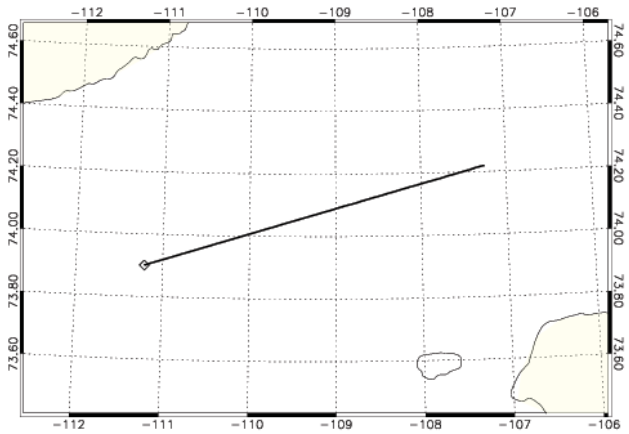


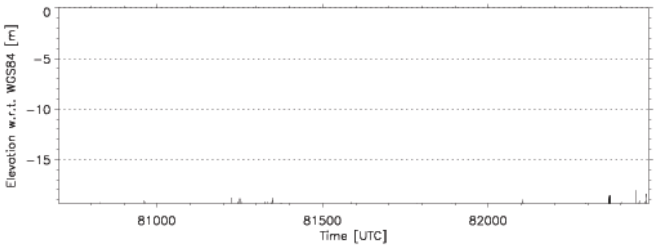


Date	2014−03−23	**Instrument Mode**	Adv. Low Altitude
Start Time	21:55:28 (78928)	**Aircraft**	DNSC Twin Otter
Stop Time	22:22:48 (80568)	**Retracker**	TSRA
Distance	119.008 km	**INS Resolution**	50 Hz
Duration	00 h 27 m 21 s	**Processor Version**	0403

A140323_07

AS30A07_ASWL1B0403201403231222503_20140323T225445_0001.DBL

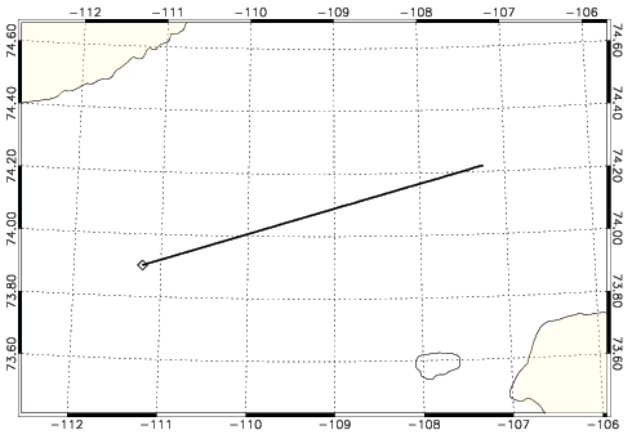


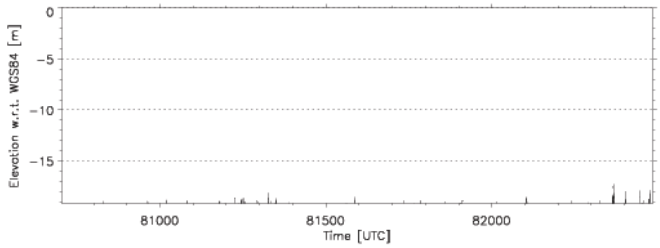


Date	2014−03−23	**Instrument Mode**	Adv. Low Altitude
Start Time	22:25:03 (80703)	**Aircraft**	DNSC Twin Otter
Stop Time	22:54:44 (82484)	**Retracker**	OCOG
Distance	125.726 km	**INS Resolution**	50 Hz
Duration	00 h 29 m 42 s	**Processor Version**	0403

A140323_07

AS30A07_ASWL1B0403201403231222503_20140323T225445_0001.DBL

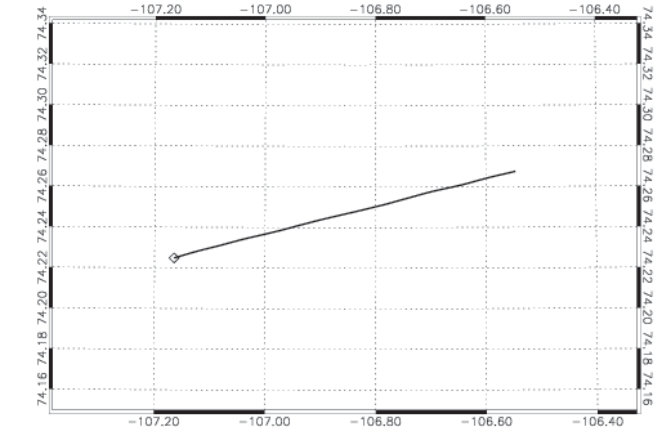


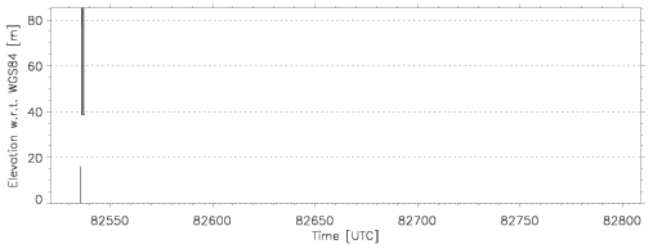


Date	2014−03−23	**Instrument Mode**	Adv. Low Altitude
Start Time	22:25:04 (80704)	**Aircraft**	DNSC Twin Otter
Stop Time	22:54:45 (82485)	**Retracker**	TSRA
Distance	125.723 km	**INS Resolution**	50 Hz
Duration	00 h 29 m 42 s	**Processor Version**	0403

A140323_08

AS3OA08_ASWL1B040320140323T225521_20140323T230009_0001.DBL

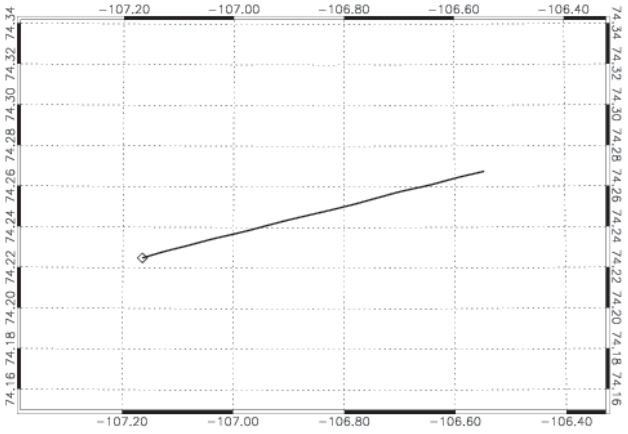


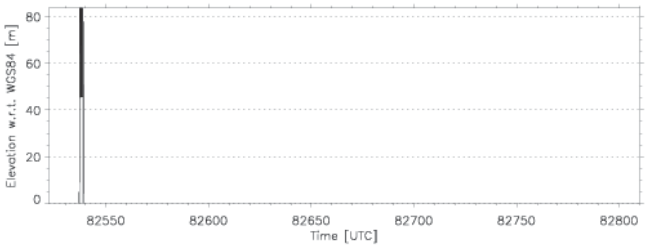


Date	2014−03−23	**Instrument Mode**	Adv. Low Altitude
Start Time	22:55:21 (82521)	**Aircraft**	DNSC Twin Otter
Stop Time	23:00:09 (82809)	**Retracker**	OCOG
Distance	19.230 km	**INS Resolution**	50 Hz
Duration	00 h 04 m 48 s	**Processor Version**	0403

A140323_08

AS3OA08_ASWL1B040320140323T225521_20140323T230009_0001.DBL

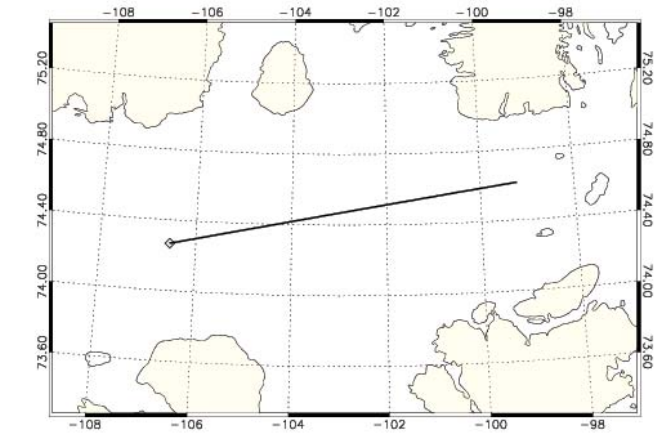


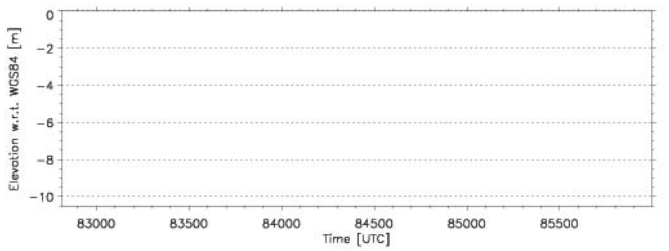


Date	2014−03−23	**Instrument Mode**	Adv. Low Altitude
Start Time	22:55:22 (82522)	**Aircraft**	DNSC Twin Otter
Stop Time	23:00:10 (82810)	**Retracker**	TSRA
Distance	19.230 km	**INS Resolution**	50 Hz
Duration	00 h 04 m 48 s	**Processor Version**	0403

A140323_09

AS3OA09_ASWL1B040320140323T230012_20140324T001910_0001.DBL

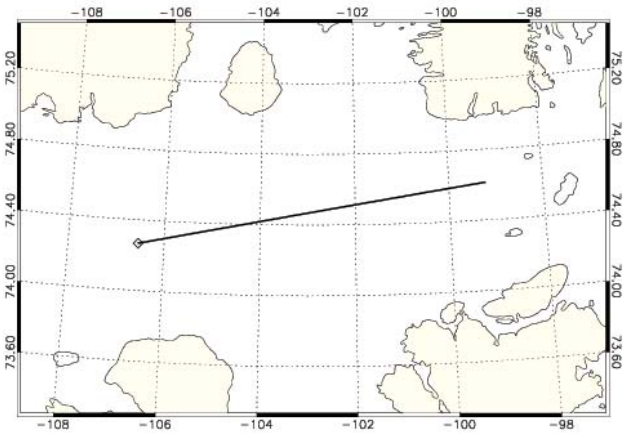


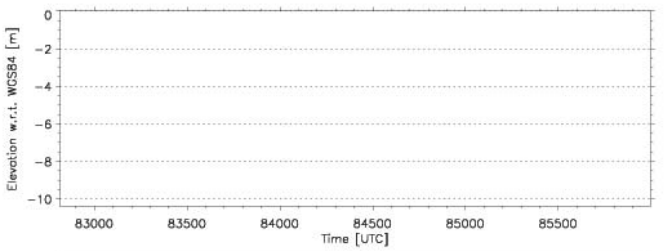


Date	2014−03−23	**Instrument Mode**	Adv. Low Altitude
Start Time	23:00:12 (82812)	**Aircraft**	DNSC Twin Otter
Stop Time	23:53:18 (85998)	**Retracker**	OCOG
Distance	221.185 km	**INS Resolution**	50 Hz
Duration	00 h 53 m 06 s	**Processor Version**	0403

A140323_09

AS3OA09_ASWL1B040320140323T230012_20140324T001910_0001.DBL

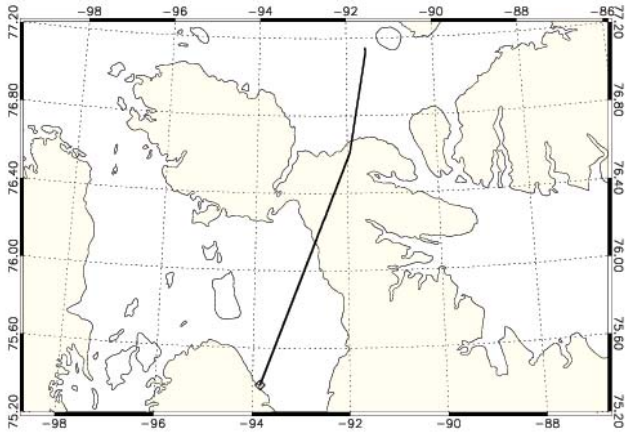


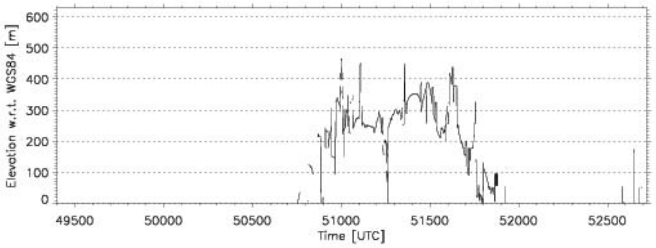


Date	2014−03−23	**Instrument Mode**	Adv. Low Altitude
Start Time	23:00:13 (82813)	**Aircraft**	DNSC Twin Otter
Stop Time	23:53:19 (85999)	**Retracker**	TSRA
Distance	221.185 km	**INS Resolution**	50 Hz
Duration	00 h 53 m 06 s	**Processor Version**	0403

A140325_00

AS30A00_ASWL1804032014032S1134317_20140325T143843_0001.DBL

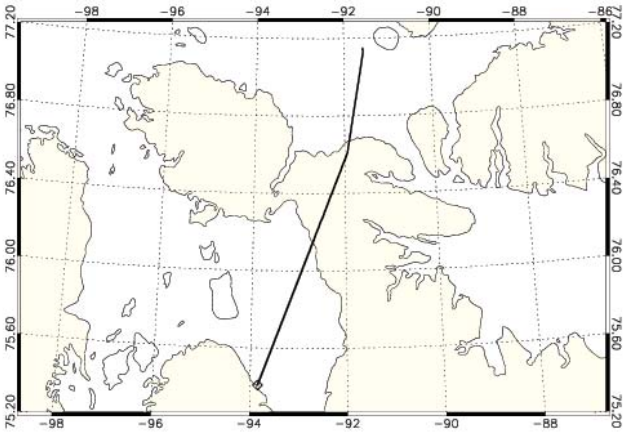


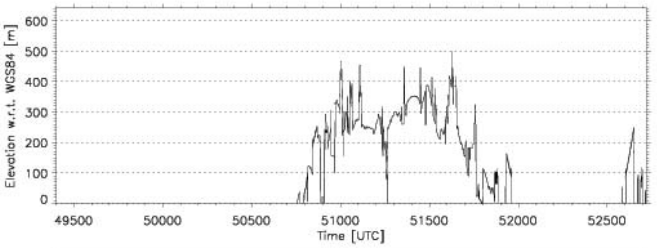


Date	2014-03-25	**Instrument Mode**	Adv. Low Altitude
Start Time	13:43:17 (49397)	**Aircraft**	DNSC Twin Otter
Stop Time	14:38:42 (52722)	**Retracker**	OCOG
Distance	203.975 km	**INS Resolution**	50 Hz
Duration	00 h 55 m 25 s	**Processor Version**	0403

A140325_00

AS30A00_ASWL1804032014032S1134317_20140325T143843_0001.DBL

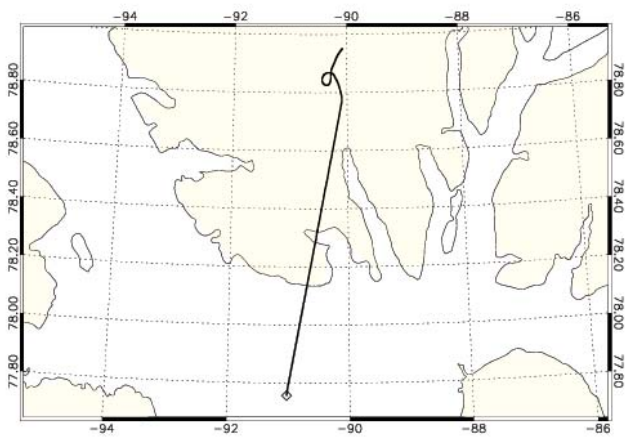


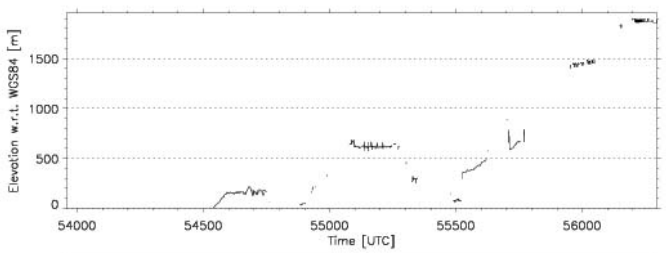


Date	2014-03-25	**Instrument Mode**	Adv. Low Altitude
Start Time	13:43:18 (49398)	**Aircraft**	DNSC Twin Otter
Stop Time	14:38:43 (52723)	**Retracker**	TSRA
Distance	203.976 km	**INS Resolution**	50 Hz
Duration	00 h 55 m 25 s	**Processor Version**	0403

A140325_01

AS30A01_ASWL1804032014032S1145918_20140325T153816_0001.DBL

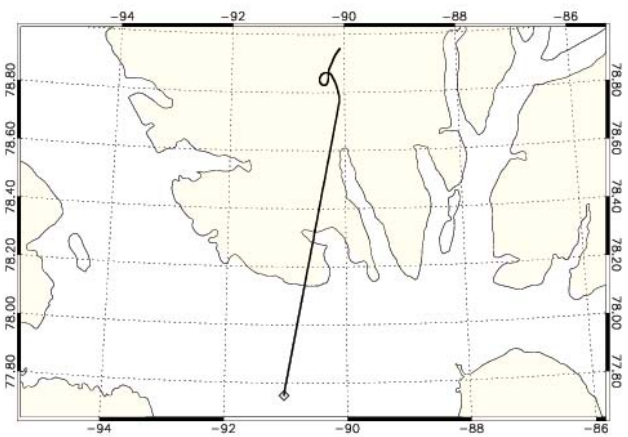


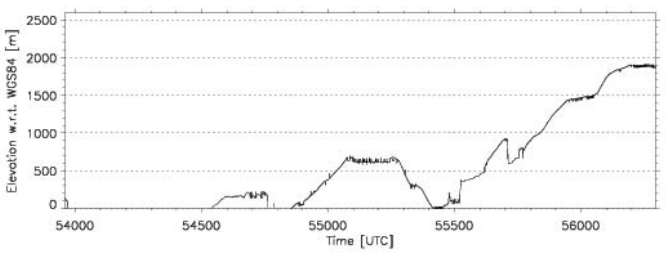


Date	2014-03-25	**Instrument Mode**	Adv. Low Altitude
Start Time	14:59:18 (53958)	**Aircraft**	DNSC Twin Otter
Stop Time	15:38:15 (56295)	**Retracker**	OCOG
Distance	150.818 km	**INS Resolution**	50 Hz
Duration	00 h 38 m 58 s	**Processor Version**	0403

A140325_01

AS30A01_ASWL1804032014032S1145918_20140325T153816_0001.DBL

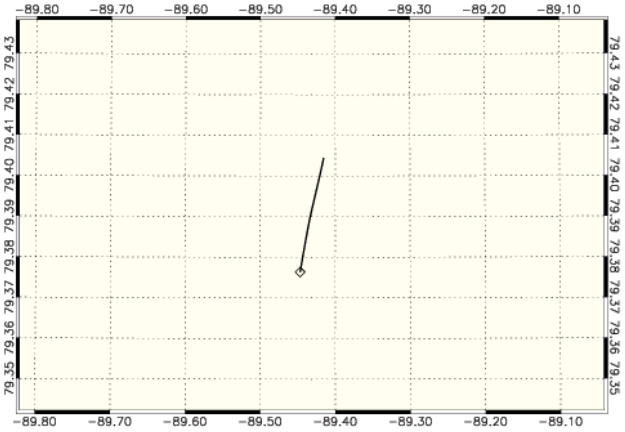


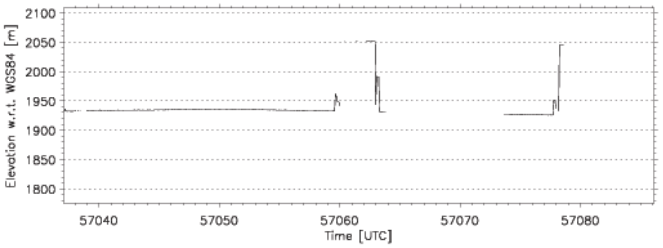


Date	2014-03-25	**Instrument Mode**	Adv. Low Altitude
Start Time	14:59:19 (53959)	**Aircraft**	DNSC Twin Otter
Stop Time	15:38:16 (56296)	**Retracker**	TSRA
Distance	150.856 km	**INS Resolution**	50 Hz
Duration	00 h 38 m 58 s	**Processor Version**	0403

A140325_02

AS30A02_ASWL1B0403201403251155037_20140325T155126_0001.DBL

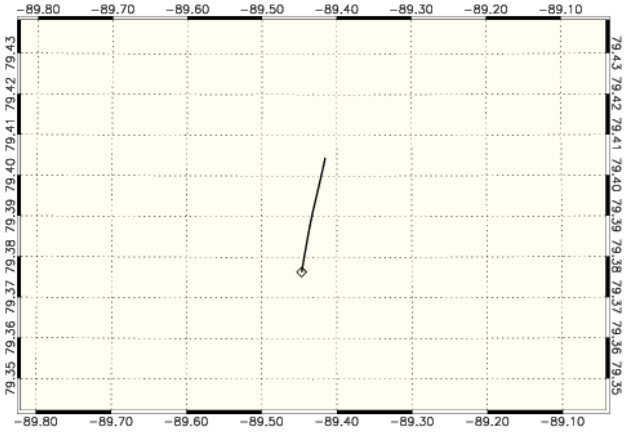


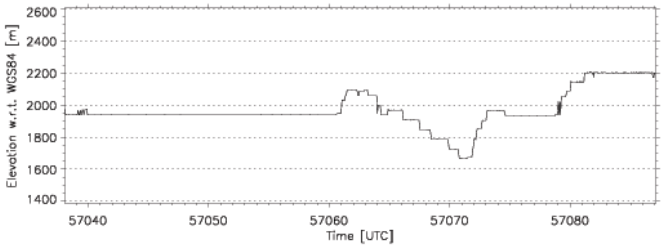


Date	2014−03−25	**Instrument Mode**	Adv. Low Altitude
Start Time	15:50:37 (57037)	**Aircraft**	DNSC Twin Otter
Stop Time	15:51:26 (57086)	**Retracker**	OCOG
Distance	3.185 km	**INS Resolution**	50 Hz
Duration	00 h 00 m 49 s	**Processor Version**	0403

A140325_02

AS30A02_ASWL1B0403201403251155037_20140325T155126_0001.DBL

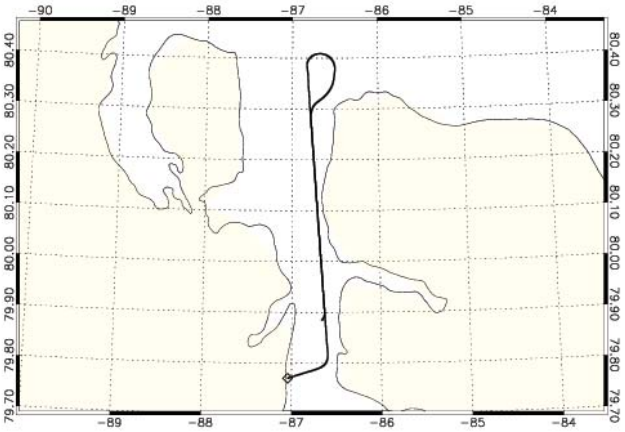


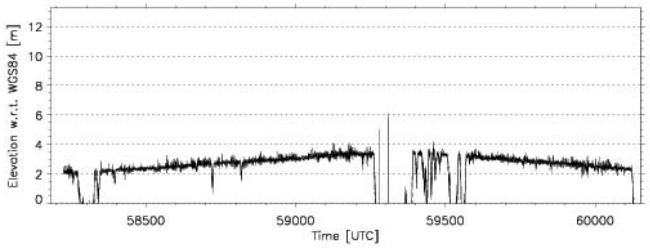


Date	2014−03−25	**Instrument Mode**	Adv. Low Altitude
Start Time	15:50:38 (57038)	**Aircraft**	DNSC Twin Otter
Stop Time	15:51:27 (57087)	**Retracker**	TSRA
Distance	3.185 km	**INS Resolution**	50 Hz
Duration	00 h 00 m 49 s	**Processor Version**	0403

A140325_03

AS30A03_ASWL1B0403201403251160941_20140325T164233_0001.DBL

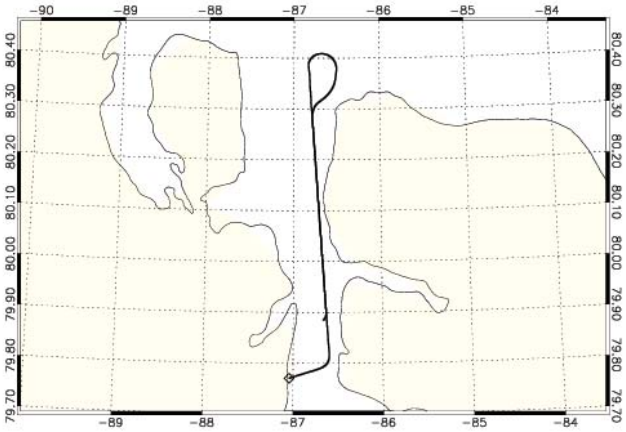


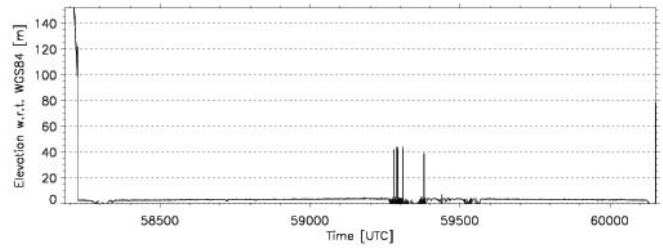


Date	2014−03−25	**Instrument Mode**	Adv. Low Altitude
Start Time	16:09:41 (58181)	**Aircraft**	DNSC Twin Otter
Stop Time	16:42:32 (60152)	**Retracker**	OCOG
Distance	140.909 km	**INS Resolution**	50 Hz
Duration	00 h 32 m 52 s	**Processor Version**	0403

A140325_03

AS30A03_ASWL1B0403201403251160941_20140325T164233_0001.DBL

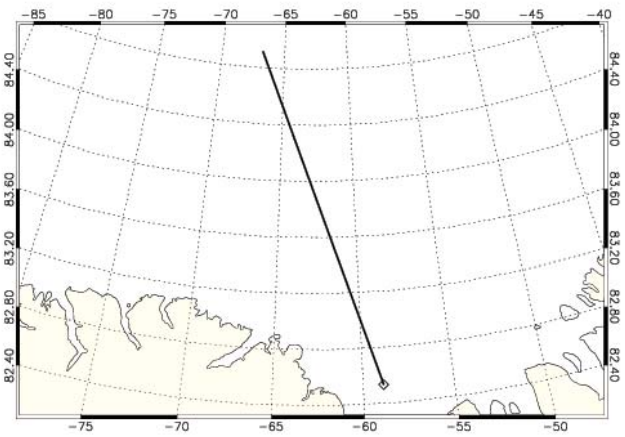


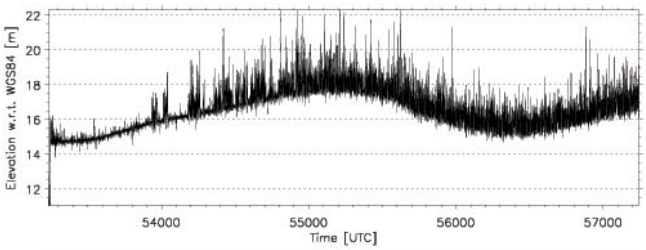


Date	2014−03−25	**Instrument Mode**	Adv. Low Altitude
Start Time	16:09:42 (58182)	**Aircraft**	DNSC Twin Otter
Stop Time	16:42:33 (60153)	**Retracker**	TSRA
Distance	140.893 km	**INS Resolution**	50 Hz
Duration	00 h 32 m 52 s	**Processor Version**	0403

A140326_00

AS3OA00_ASWL1B0403201403261144713_20140326T155403_0001.DBL

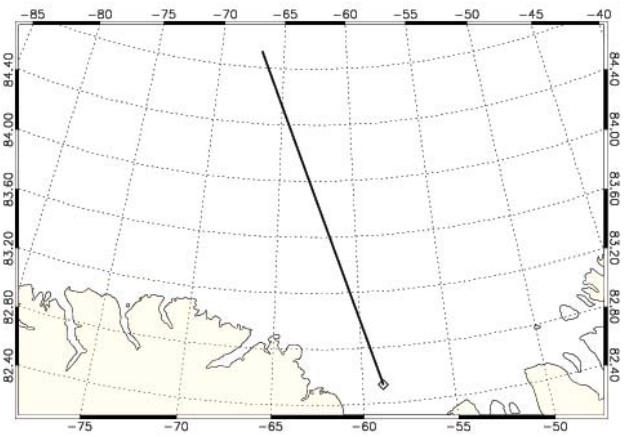


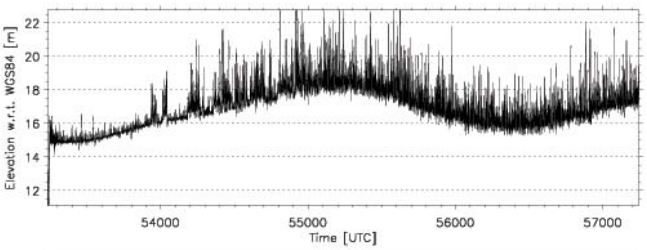


Date	2014-03-26	**Instrument Mode**	Adv. Low Altitude
Start Time	14:47:13 (53233)	**Aircraft**	DNSC Twin Otter
Stop Time	15:54:02 (57242)	**Retracker**	OCOG
Distance	280.974 km	**INS Resolution**	50 Hz
Duration	01 h 06 m 50 s	**Processor Version**	0403

A140326_00

AS3OA00_ASWL1B0403201403261144713_20140326T155403_0001.DBL

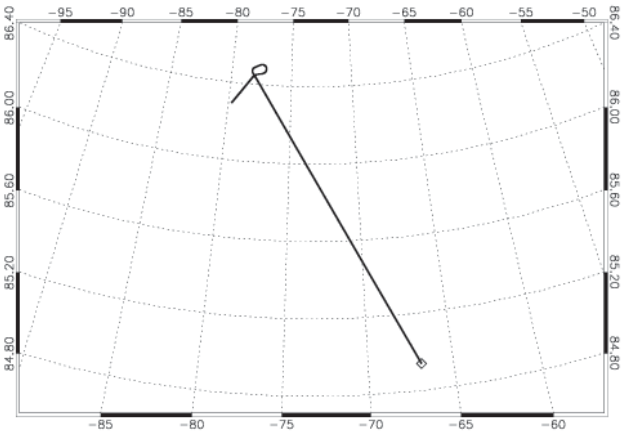


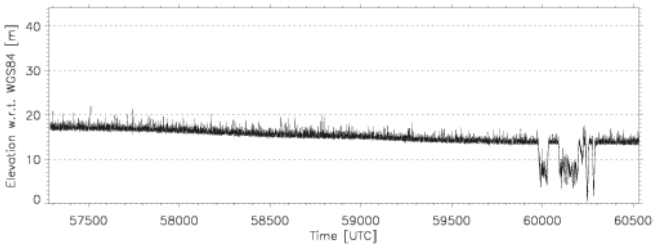


Date	2014-03-26	**Instrument Mode**	Adv. Low Altitude
Start Time	14:47:14 (53234)	**Aircraft**	DNSC Twin Otter
Stop Time	15:54:03 (57243)	**Retracker**	TSRA
Distance	280.792 km	**INS Resolution**	50 Hz
Duration	01 h 06 m 50 s	**Processor Version**	0403

A140326_01

AS3OA01_ASWL1B0403201403261155439_20140326T164852_0001.DBL

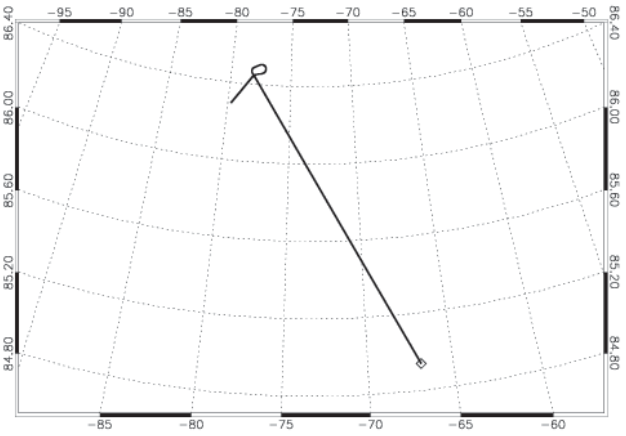


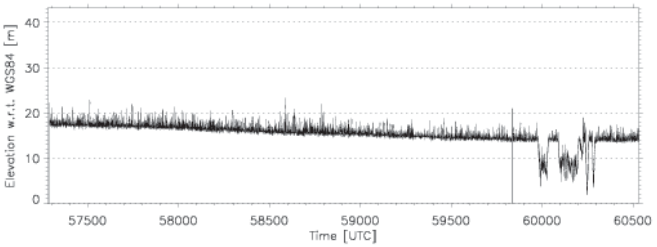


Date	2014-03-26	**Instrument Mode**	Adv. Low Altitude
Start Time	15:54:39 (57279)	**Aircraft**	DNSC Twin Otter
Stop Time	16:48:51 (60531)	**Retracker**	OCOG
Distance	234.285 km	**INS Resolution**	50 Hz
Duration	00 h 54 m 13 s	**Processor Version**	0403

A140326_01

AS3OA01_ASWL1B0403201403261155439_20140326T164852_0001.DBL

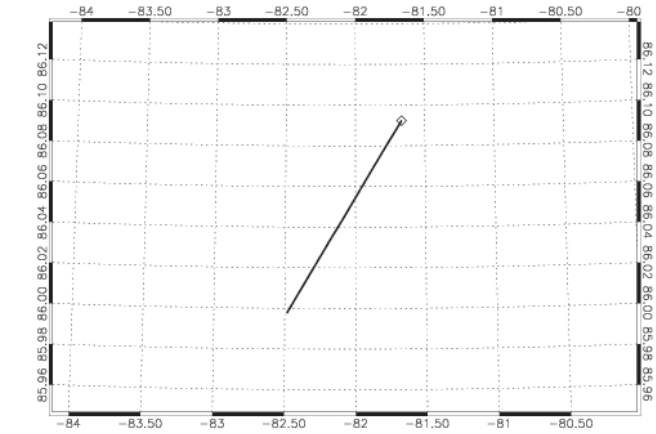


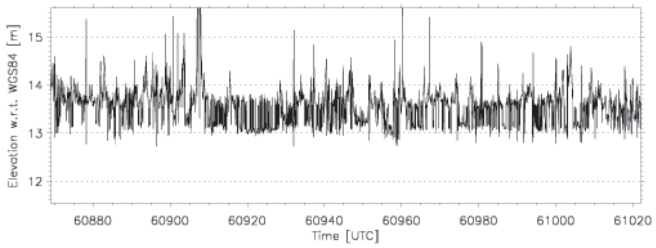


Date	2014-03-26	**Instrument Mode**	Adv. Low Altitude
Start Time	15:54:40 (57280)	**Aircraft**	DNSC Twin Otter
Stop Time	16:48:52 (60532)	**Retracker**	TSRA
Distance	234.203 km	**INS Resolution**	50 Hz
Duration	00 h 54 m 13 s	**Processor Version**	0403

A140326_02

AS30A02_ASWL1B0403201403261165429_20140326T165702_0001.DBL

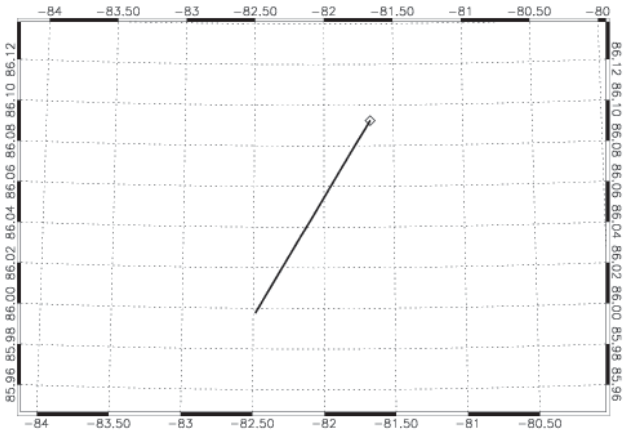


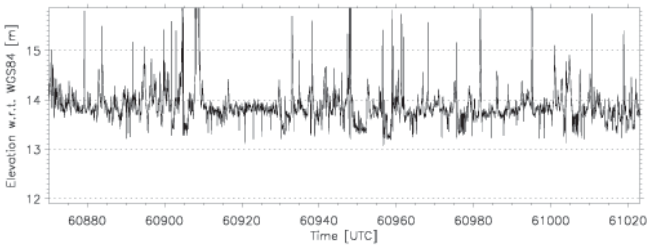


Date	2014−03−26	**Instrument Mode**	Adv. Low Altitude
Start Time	16:54:29 (60869)	**Aircraft**	DNSC Twin Otter
Stop Time	16:57:02 (61022)	**Retracker**	OCOG
Distance	12.227 km	**INS Resolution**	50 Hz
Duration	00 h 02 m 33 s	**Processor Version**	0403

A140326_02

AS30A02_ASWL1B0403201403261165429_20140326T165702_0001.DBL

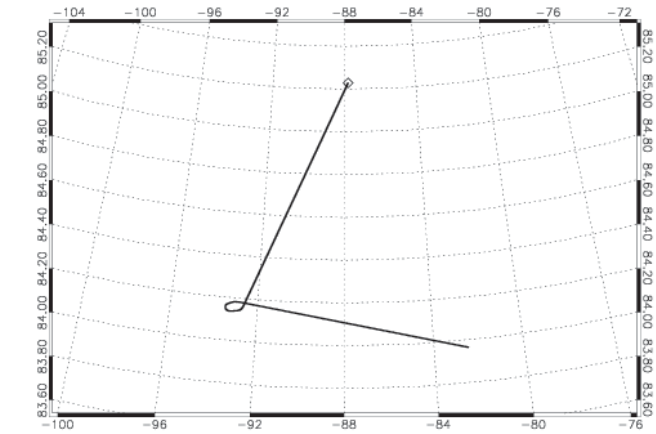


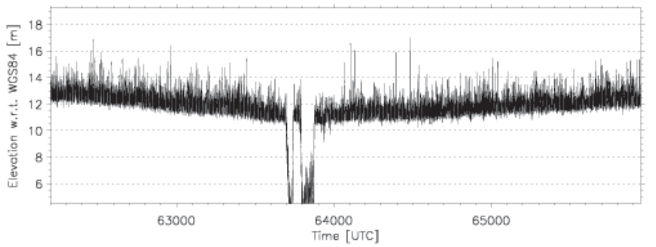


Date	2014−03−26	**Instrument Mode**	Adv. Low Altitude
Start Time	16:54:30 (60870)	**Aircraft**	DNSC Twin Otter
Stop Time	16:57:03 (61023)	**Retracker**	TSRA
Distance	12.227 km	**INS Resolution**	50 Hz
Duration	00 h 02 m 33 s	**Processor Version**	0403

A140326_04

AS30A04_ASWL1B0403201403261171640_20140326T181911_0001.DBL

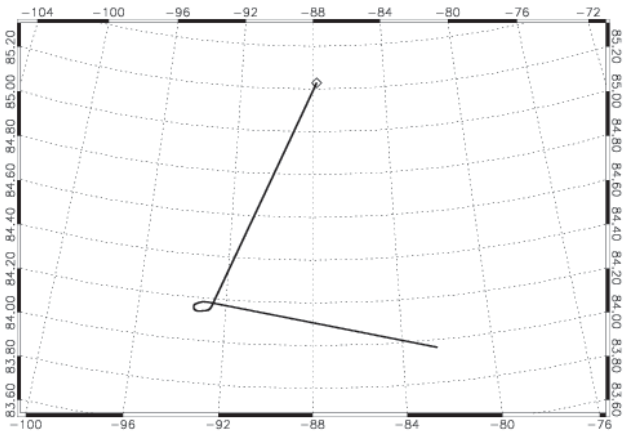


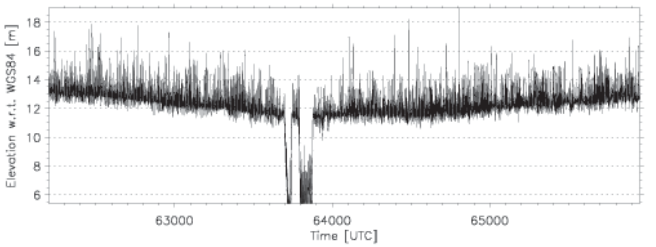


Date	2014−03−26	**Instrument Mode**	Adv. Low Altitude
Start Time	17:16:40 (62200)	**Aircraft**	DNSC Twin Otter
Stop Time	18:19:11 (65951)	**Retracker**	OCOG
Distance	269.620 km	**INS Resolution**	50 Hz
Duration	01 h 02 m 31 s	**Processor Version**	0403

A140326_04

AS30A04_ASWL1B0403201403261171640_20140326T181911_0001.DBL

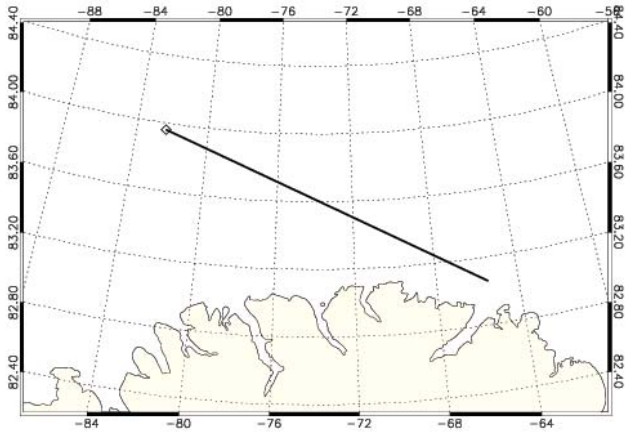


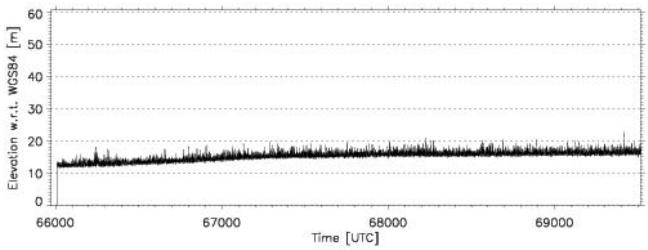


Date	2014−03−26	**Instrument Mode**	Adv. Low Altitude
Start Time	17:16:41 (62201)	**Aircraft**	DNSC Twin Otter
Stop Time	18:19:12 (65952)	**Retracker**	TSRA
Distance	269.739 km	**INS Resolution**	50 Hz
Duration	01 h 02 m 31 s	**Processor Version**	0403

A140326_05

AS3OA05_ASWL1B0403201403261181931_20140326T191839_0001.DBL

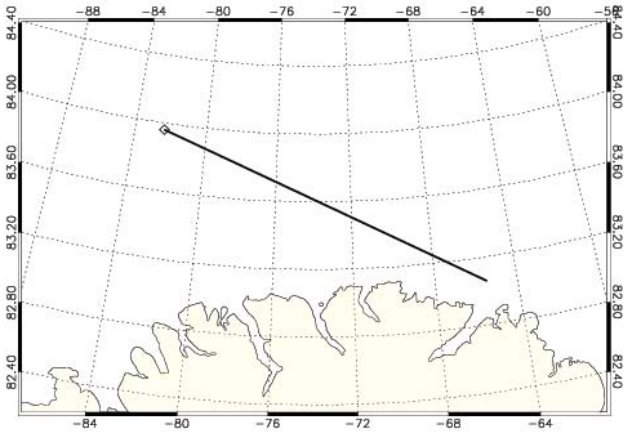


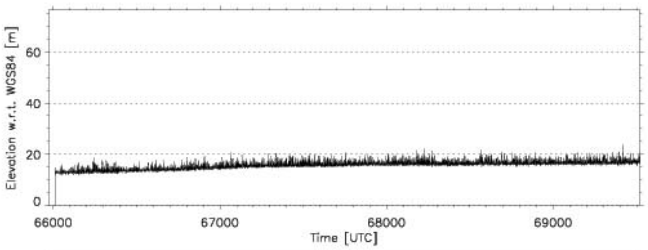


Date	2014-03-26	**Instrument Mode**	Adv. Low Altitude
Start Time	18:19:31 (65971)	**Aircraft**	DNSC Twin Otter
Stop Time	19:18:38 (69518)	**Retracker**	OCOG
Distance	233.051 km	**INS Resolution**	50 Hz
Duration	00 h 59 m 08 s	**Processor Version**	0403

A140326_05

AS3OA05_ASWL1B0403201403261181931_20140326T191839_0001.DBL

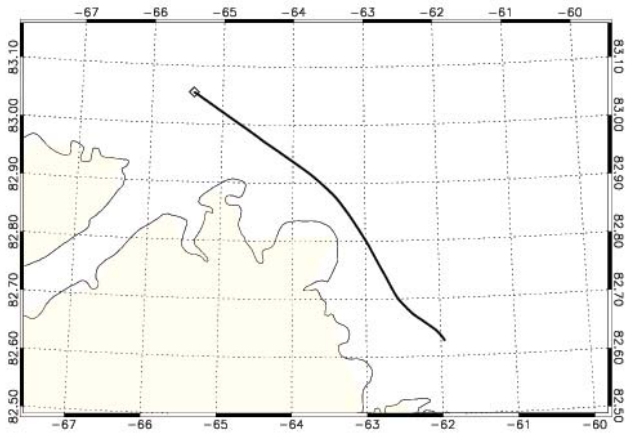


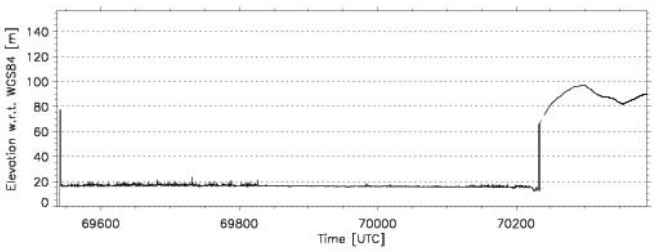


Date	2014-03-26	**Instrument Mode**	Adv. Low Altitude
Start Time	18:19:32 (65972)	**Aircraft**	DNSC Twin Otter
Stop Time	19:18:39 (69519)	**Retracker**	TSRA
Distance	232.996 km	**INS Resolution**	50 Hz
Duration	00 h 59 m 08 s	**Processor Version**	0403

A140326_06

AS3OA06_ASWL1B0403201403261191856_20140326T193309_0001.DBL

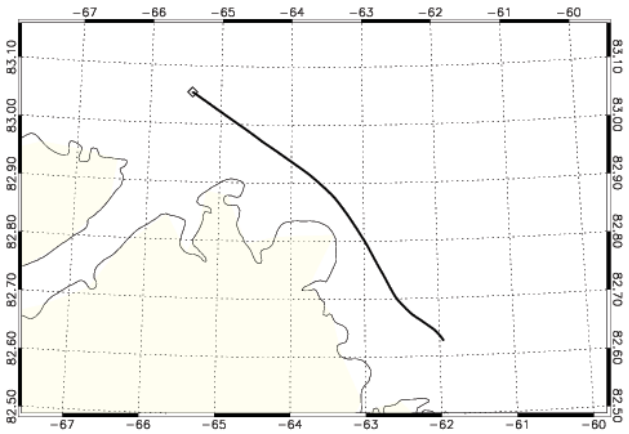


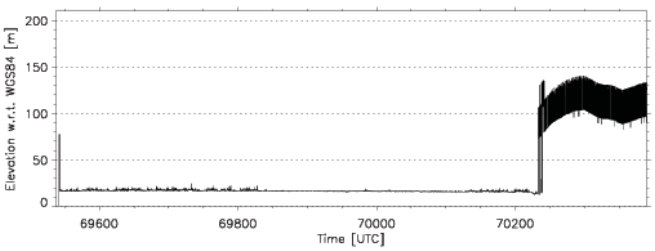


Date	2014-03-26	**Instrument Mode**	Adv. Low Altitude
Start Time	19:18:56 (69536)	**Aircraft**	DNSC Twin Otter
Stop Time	19:33:09 (70389)	**Retracker**	OCOG
Distance	68.586 km	**INS Resolution**	50 Hz
Duration	00 h 14 m 13 s	**Processor Version**	0403

A140326_06

AS3OA06_ASWL1B0403201403261191856_20140326T193309_0001.DBL

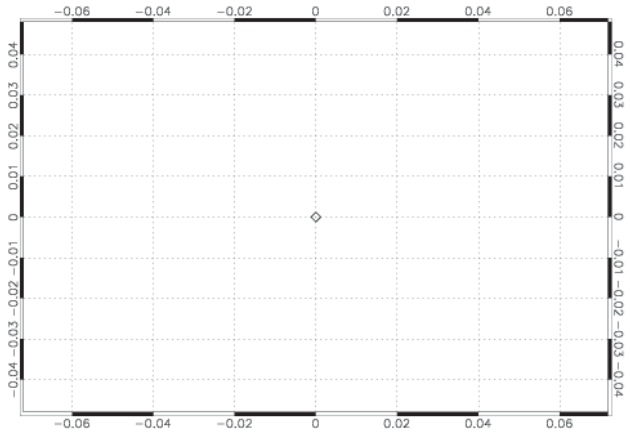




Date	2014-03-26	**Instrument Mode**	Adv. Low Altitude
Start Time	19:18:57 (69537)	**Aircraft**	DNSC Twin Otter
Stop Time	19:33:10 (70390)	**Retracker**	TSRA
Distance	68.583 km	**INS Resolution**	50 Hz
Duration	00 h 14 m 13 s	**Processor Version**	0403

A140326_07

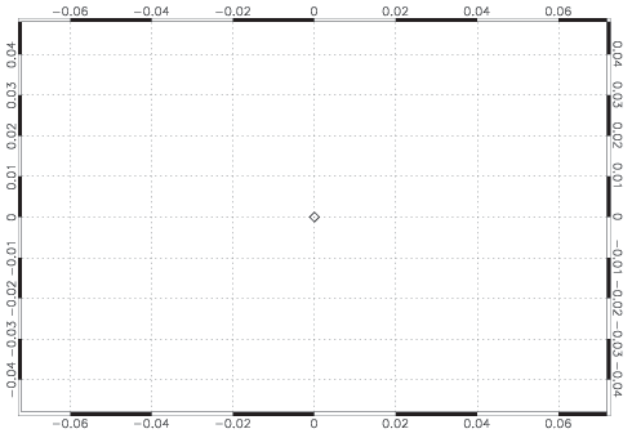
AS3OA07_ASWL1B0403201403261193313_20140326T193315_0001.DBL



Date	2014-03-26	**Instrument Mode**	Adv. Low Altitude
Start Time	**:59:25 (*****)	**Aircraft**	DNSC Twin Otter
Stop Time	**:59:25 (*****)	**Retracker**	OCOG
Distance	0.000 km	**INS Resolution**	50 Hz
Duration	00 h 00 m 00 s	**Processor Version**	0403

A140326_07

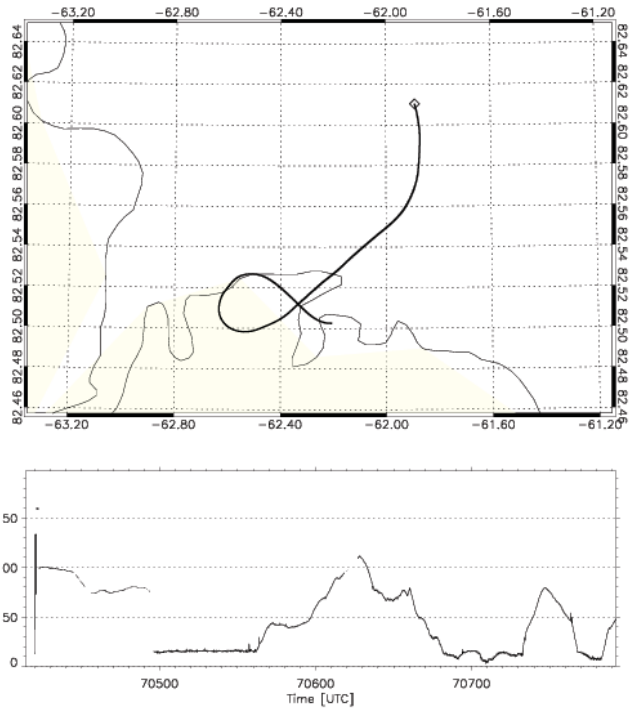
AS3OA07_ASWL1B0403201403261193313_20140326T193315_0001.DBL



Date	2014-03-26	**Instrument Mode**	Adv. Low Altitude
Start Time	**:59:26 (*****)	**Aircraft**	DNSC Twin Otter
Stop Time	**:59:26 (*****)	**Retracker**	TSRA
Distance	0.000 km	**INS Resolution**	50 Hz
Duration	00 h 00 m 00 s	**Processor Version**	0403

A140326_08

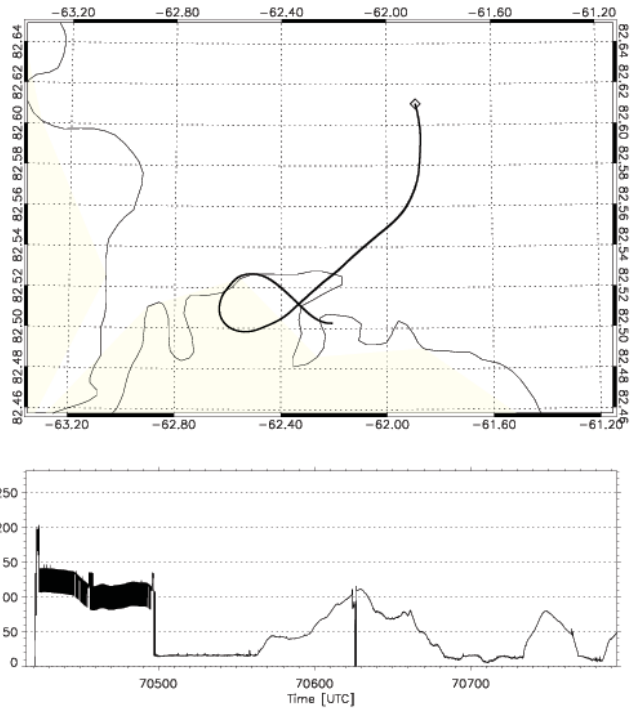
AS3OA08_ASWL1B0403201403261193334_20140326T193953_0001.DBL



Date	2014-03-26	**Instrument Mode**	Adv. Low Altitude
Start Time	19:33:34 (70414)	**Aircraft**	DNSC Twin Otter
Stop Time	19:39:52 (70792)	**Retracker**	OCOG
Distance	27.366 km	**INS Resolution**	50 Hz
Duration	00 h 06 m 19 s	**Processor Version**	0403

A140326_08

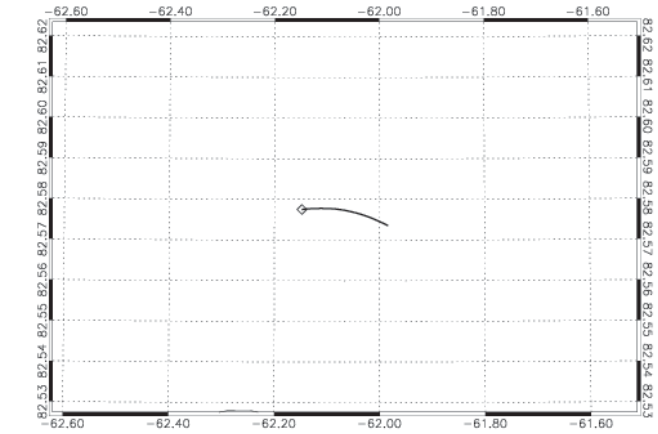
AS3OA08_ASWL1B0403201403261193334_20140326T193953_0001.DBL

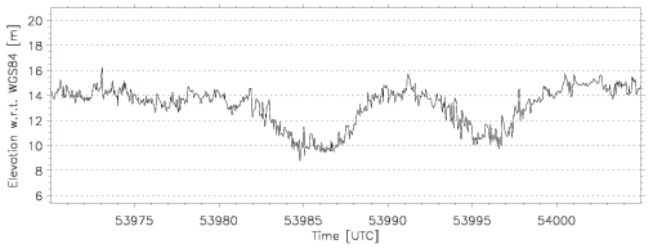


Date	2014-03-26	**Instrument Mode**	Adv. Low Altitude
Start Time	19:33:35 (70415)	**Aircraft**	DNSC Twin Otter
Stop Time	19:39:53 (70793)	**Retracker**	TSRA
Distance	27.366 km	**INS Resolution**	50 Hz
Duration	00 h 06 m 19 s	**Processor Version**	0403

A140328_00

AS30A00_ASWL1B0403201403287145930_20140328T150005_0001.DBL

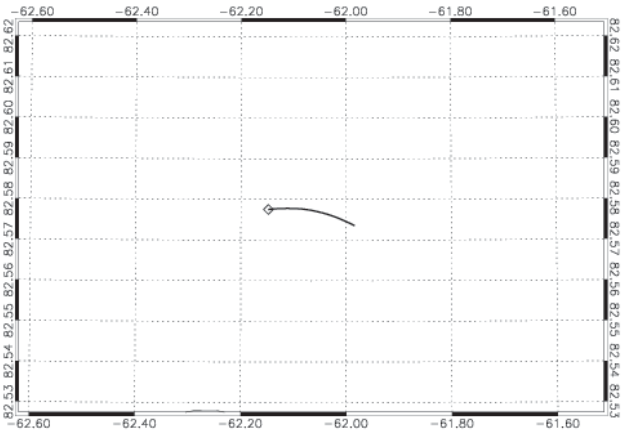


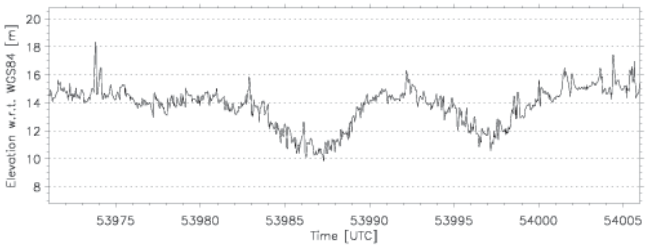


Date	2014−03−28	**Instrument Mode**	Adv. Low Altitude
Start Time	14:59:30 (53970)	**Aircraft**	DNSC Twin Otter
Stop Time	15:00:04 (54004)	**Retracker**	OCOG
Distance	2.432 km	**INS Resolution**	50 Hz
Duration	00 h 00 m 35 s	**Processor Version**	0403

A140328_00

AS30A00_ASWL1B0403201403287145930_20140328T150005_0001.DBL

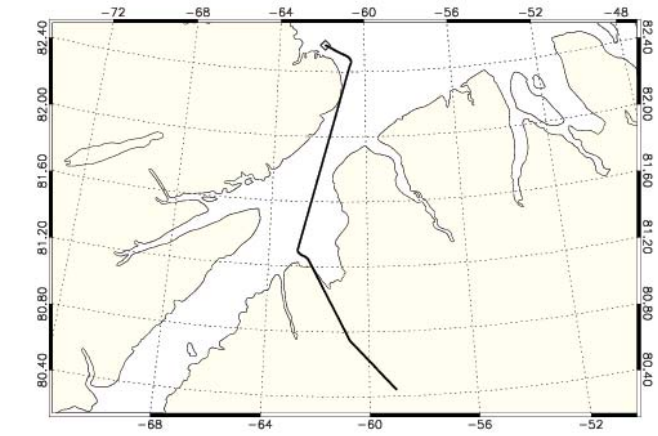


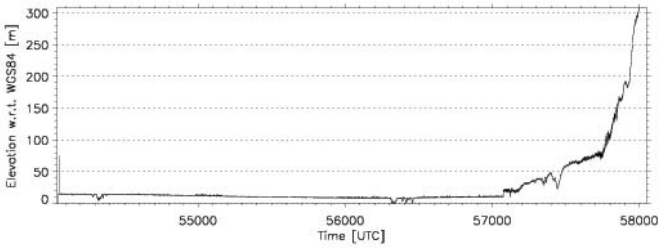


Date	2014−03−28	**Instrument Mode**	Adv. Low Altitude
Start Time	14:59:31 (53971)	**Aircraft**	DNSC Twin Otter
Stop Time	15:00:05 (54005)	**Retracker**	TSRA
Distance	2.432 km	**INS Resolution**	50 Hz
Duration	00 h 00 m 35 s	**Processor Version**	0403

A140328_01

AS30A01_ASWL1B0403201403287150037_20140328T160731_0001.DBL

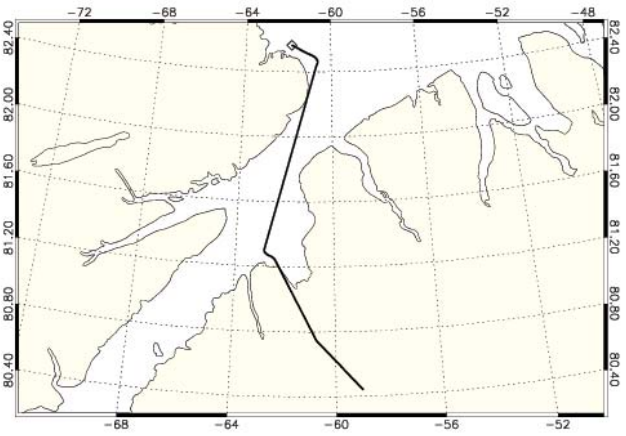


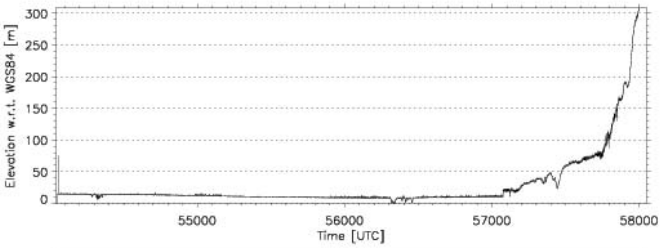


Date	2014−03−28	**Instrument Mode**	Adv. Low Altitude
Start Time	15:00:37 (54037)	**Aircraft**	DNSC Twin Otter
Stop Time	16:07:30 (58050)	**Retracker**	OCOG
Distance	274.260 km	**INS Resolution**	50 Hz
Duration	01 h 06 m 53 s	**Processor Version**	0403

A140328_01

AS30A01_ASWL1B0403201403287150037_20140328T160731_0001.DBL

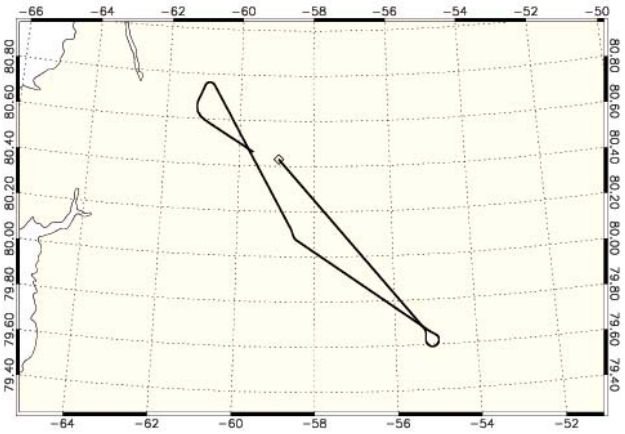


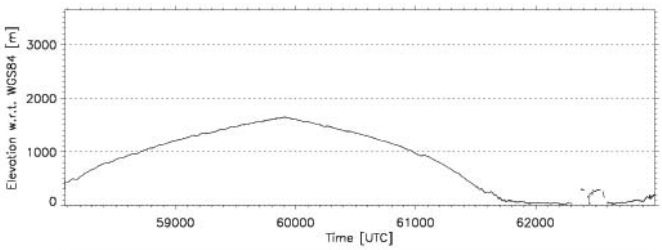


Date	2014−03−28	**Instrument Mode**	Adv. Low Altitude
Start Time	15:00:38 (54038)	**Aircraft**	DNSC Twin Otter
Stop Time	16:07:31 (58051)	**Retracker**	TSRA
Distance	274.540 km	**INS Resolution**	50 Hz
Duration	01 h 06 m 53 s	**Processor Version**	0403

A140328_02

AS30A02_ASWL1804032014032BT160754_20140328T172955_0001.DBL

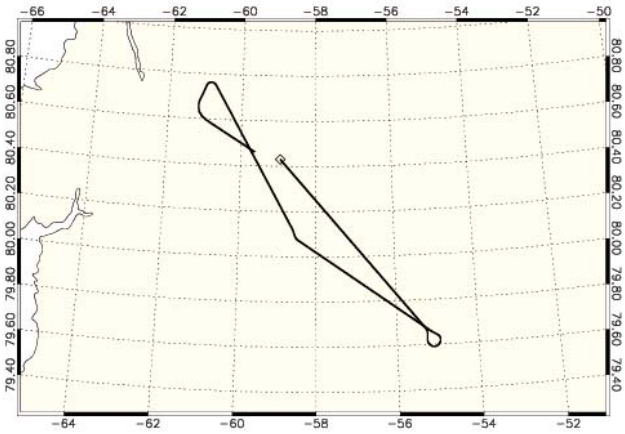


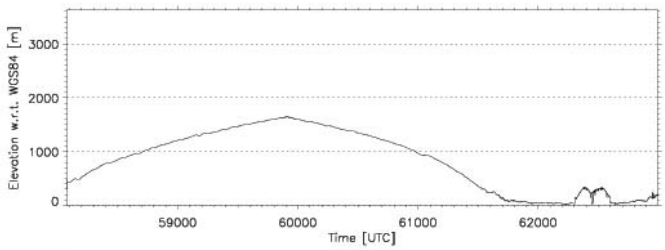


Date	2014−03−28	**Instrument Mode**	Adv. Low Altitude
Start Time	16:07:54 (58074)	**Aircraft**	DNSC Twin Otter
Stop Time	17:29:54 (62994)	**Retracker**	OCOG
Distance	350.933 km	**INS Resolution**	50 Hz
Duration	01 h 22 m 01 s	**Processor Version**	0403

A140328_02

AS30A02_ASWL1804032014032BT160754_20140328T172955_0001.DBL

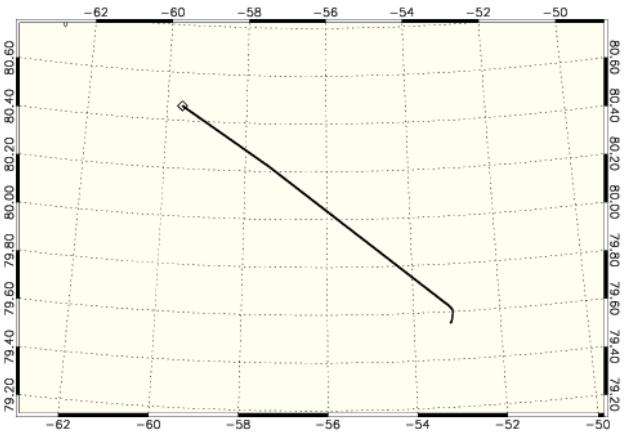


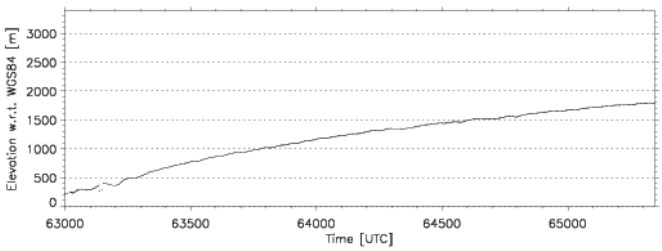


Date	2014−03−28	**Instrument Mode**	Adv. Low Altitude
Start Time	16:07:55 (58075)	**Aircraft**	DNSC Twin Otter
Stop Time	17:29:55 (62995)	**Retracker**	TSRA
Distance	350.805 km	**INS Resolution**	50 Hz
Duration	01 h 22 m 01 s	**Processor Version**	0403

A140328_03

AS30A03_ASWL1804032014032BT172958_20140328T180907_0001.DBL

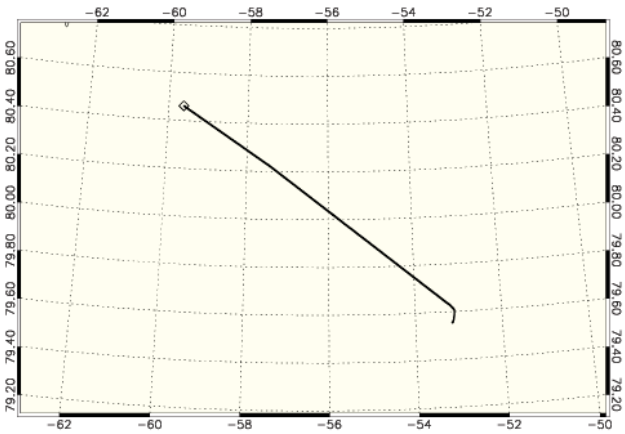


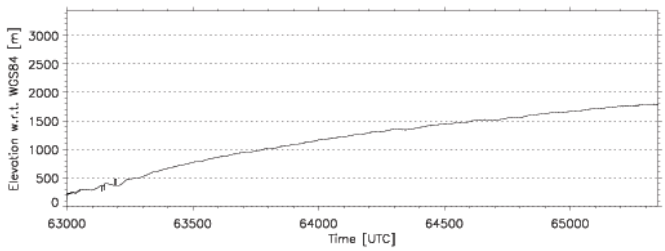


Date	2014−03−28	**Instrument Mode**	Adv. Low Altitude
Start Time	17:29:58 (62998)	**Aircraft**	DNSC Twin Otter
Stop Time	18:09:06 (65346)	**Retracker**	OCOG
Distance	163.403 km	**INS Resolution**	50 Hz
Duration	00 h 39 m 09 s	**Processor Version**	0403

A140328_03

AS30A03_ASWL1804032014032BT172958_20140328T180907_0001.DBL

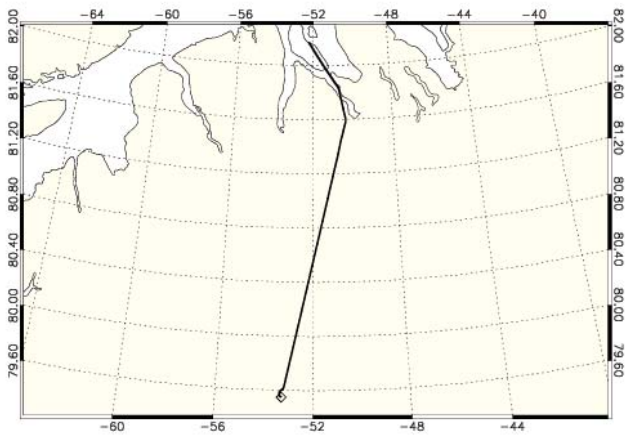


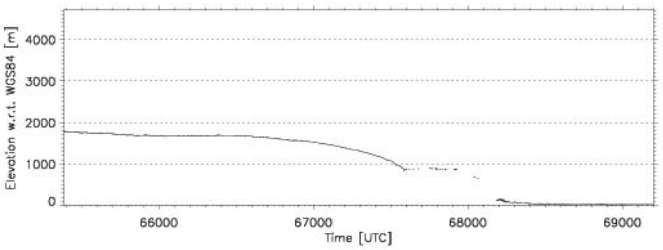


Date	2014−03−28	**Instrument Mode**	Adv. Low Altitude
Start Time	17:29:59 (62999)	**Aircraft**	DNSC Twin Otter
Stop Time	18:09:07 (65347)	**Retracker**	TSRA
Distance	163.369 km	**INS Resolution**	50 Hz
Duration	00 h 39 m 09 s	**Processor Version**	0403

A140328_04

AS3OA04_ASWL180403201403281180942_20140328T191324_0001.DBL

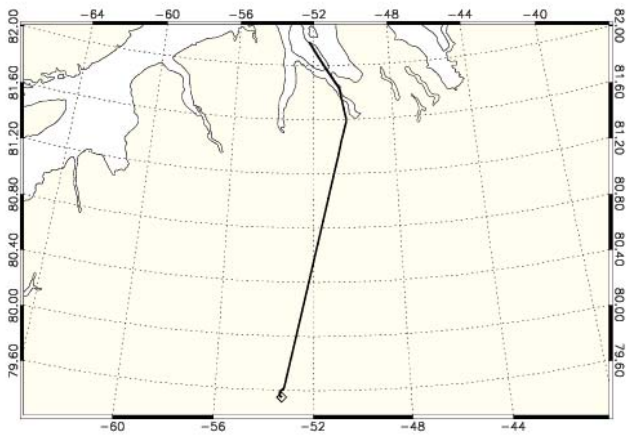


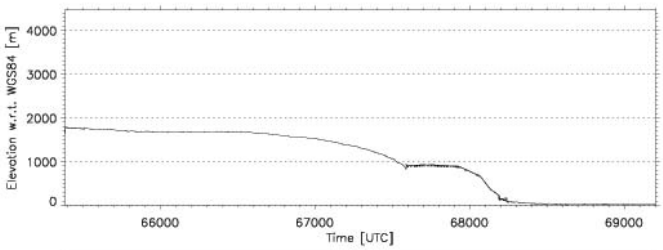


Date	2014−03−28	**Instrument Mode**	Adv. Low Altitude
Start Time	18:09:42 (65382)	**Aircraft**	DNSC Twin Otter
Stop Time	19:13:23 (69203)	**Retracker**	OCOG
Distance	306.986 km	**INS Resolution**	50 Hz
Duration	01 h 03 m 42 s	**Processor Version**	0403

A140328_04

AS3OA04_ASWL180403201403281180942_20140328T191324_0001.DBL

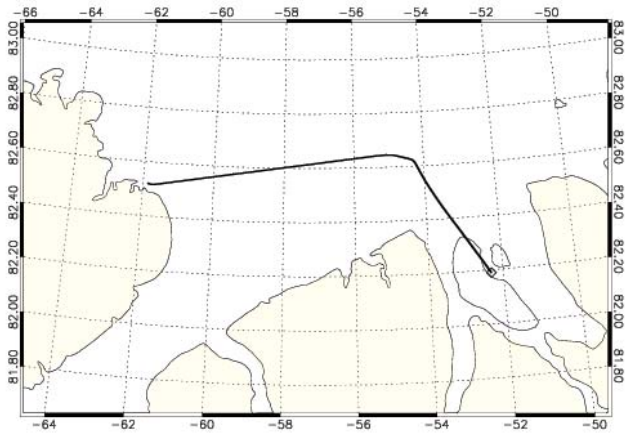


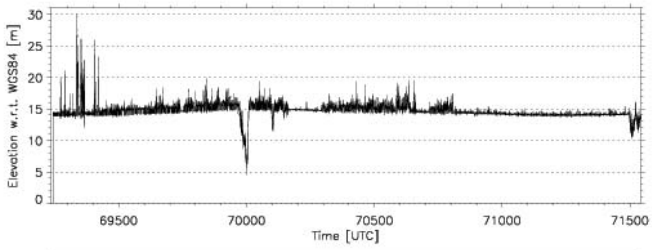


Date	2014−03−28	**Instrument Mode**	Adv. Low Altitude
Start Time	18:09:43 (65383)	**Aircraft**	DNSC Twin Otter
Stop Time	19:13:24 (69204)	**Retracker**	TSRA
Distance	306.943 km	**INS Resolution**	50 Hz
Duration	01 h 03 m 42 s	**Processor Version**	0403

A140328_05

AS3OA05_ASWL180403201403281191353_20140328T195223_0001.DBL

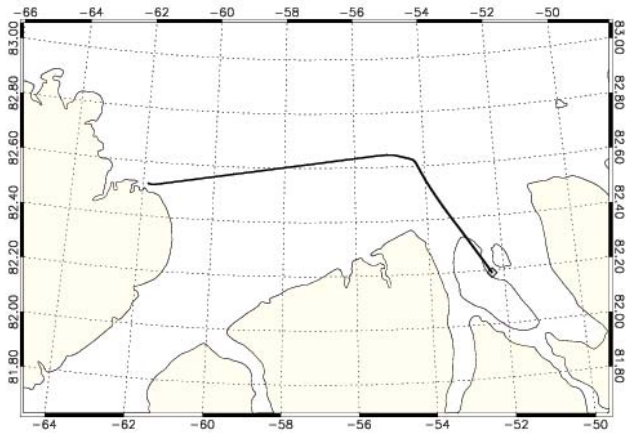


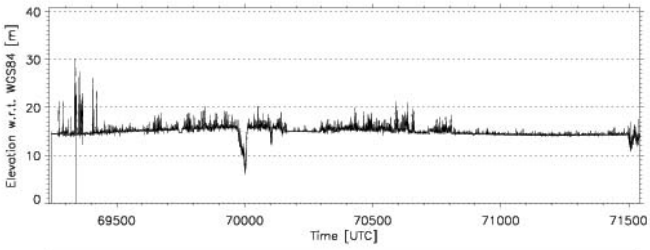


Date	2014−03−28	**Instrument Mode**	Adv. Low Altitude
Start Time	19:13:53 (69233)	**Aircraft**	DNSC Twin Otter
Stop Time	19:52:22 (71542)	**Retracker**	OCOG
Distance	166.135 km	**INS Resolution**	50 Hz
Duration	00 h 38 m 30 s	**Processor Version**	0403

A140328_05

AS3OA05_ASWL180403201403281191353_20140328T195223_0001.DBL

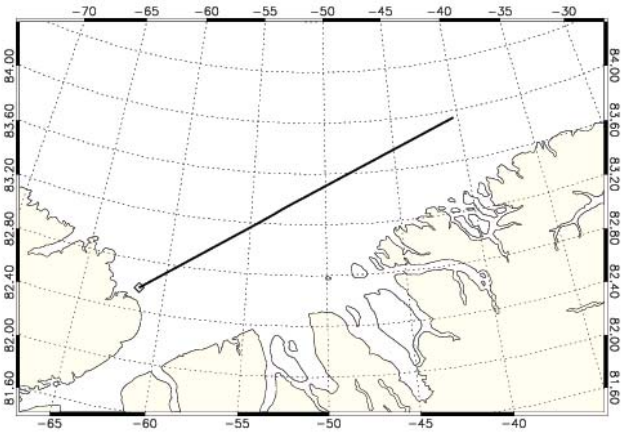


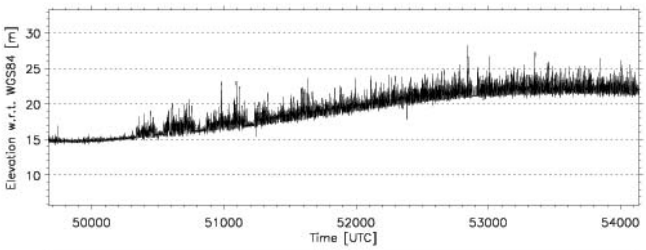


Date	2014−03−28	**Instrument Mode**	Adv. Low Altitude
Start Time	19:13:54 (69234)	**Aircraft**	DNSC Twin Otter
Stop Time	19:52:23 (71543)	**Retracker**	TSRA
Distance	166.136 km	**INS Resolution**	50 Hz
Duration	00 h 38 m 30 s	**Processor Version**	0403

A140329_00

AS3OA00_ASWL1B040320140329T134753_20140329T150219_0001.DBL

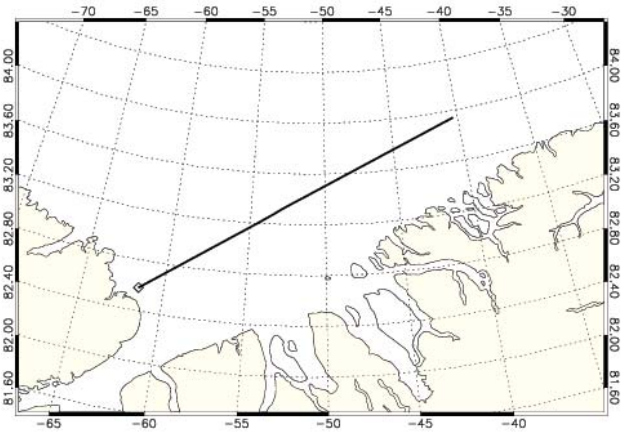


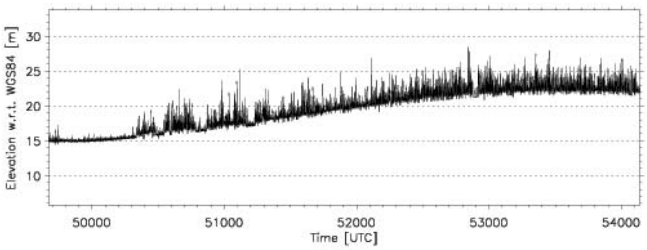


Date	2014-03-29	**Instrument Mode**	Adv. Low Altitude
Start Time	13:47:53 (49673)	**Aircraft**	DNSC Twin Otter
Stop Time	15:02:18 (54138)	**Retracker**	OCOG
Distance	311.996 km	**INS Resolution**	50 Hz
Duration	01 h 14 m 26 s	**Processor Version**	0403

A140329_00

AS3OA00_ASWL1B040320140329T134753_20140329T150219_0001.DBL

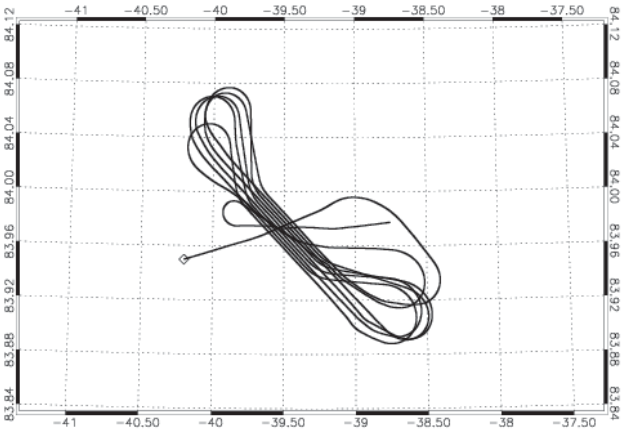


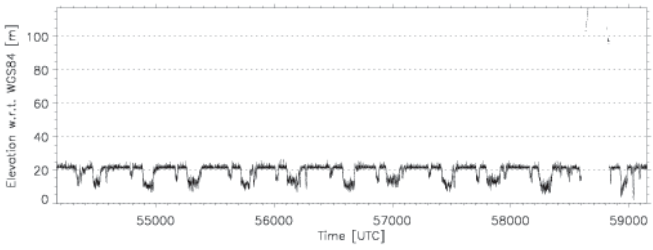


Date	2014-03-29	**Instrument Mode**	Adv. Low Altitude
Start Time	13:47:54 (49674)	**Aircraft**	DNSC Twin Otter
Stop Time	15:02:19 (54139)	**Retracker**	TSRA
Distance	311.849 km	**INS Resolution**	50 Hz
Duration	01 h 14 m 26 s	**Processor Version**	0403

A140329_01

AS3OA01_ASWL1B040320140329T150241_20140329T162553_0001.DBL

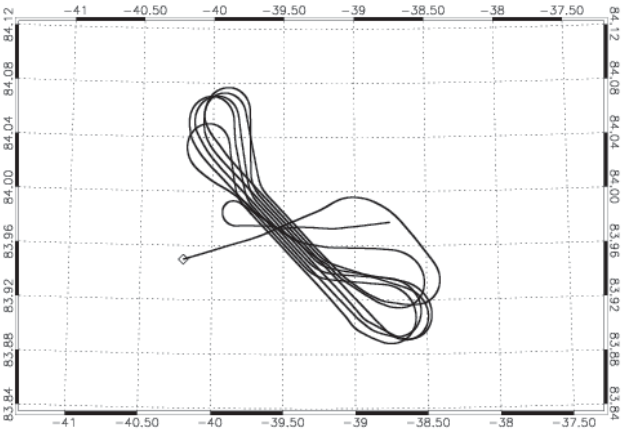


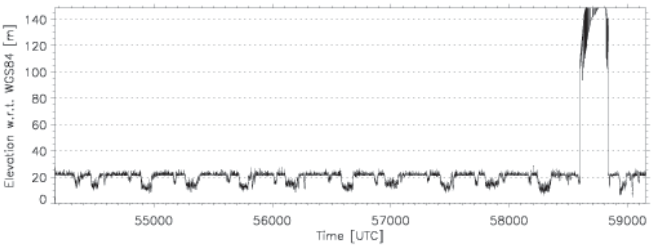


Date	2014-03-29	**Instrument Mode**	Adv. Low Altitude
Start Time	15:02:41 (54161)	**Aircraft**	DNSC Twin Otter
Stop Time	16:25:52 (59152)	**Retracker**	OCOG
Distance	350.971 km	**INS Resolution**	50 Hz
Duration	01 h 23 m 12 s	**Processor Version**	0403

A140329_01

AS3OA01_ASWL1B040320140329T150241_20140329T162553_0001.DBL

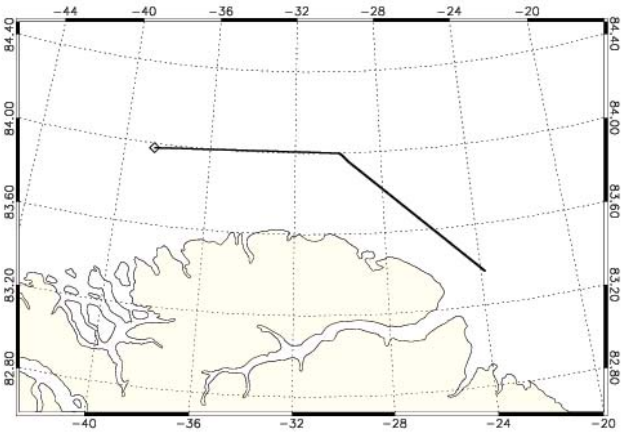


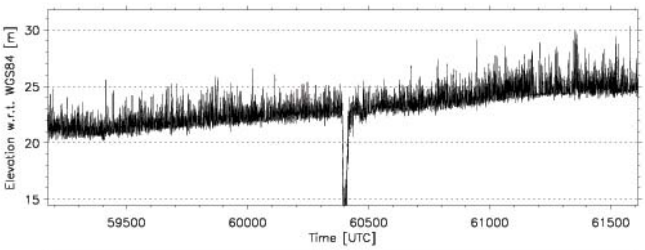


Date	2014-03-29	**Instrument Mode**	Adv. Low Altitude
Start Time	15:02:42 (54162)	**Aircraft**	DNSC Twin Otter
Stop Time	16:25:53 (59153)	**Retracker**	TSRA
Distance	350.971 km	**INS Resolution**	50 Hz
Duration	01 h 23 m 12 s	**Processor Version**	0403

A140329_02

AS3OA02_ASWL1B040320140329T162613_20140329T170652_0001.DBL

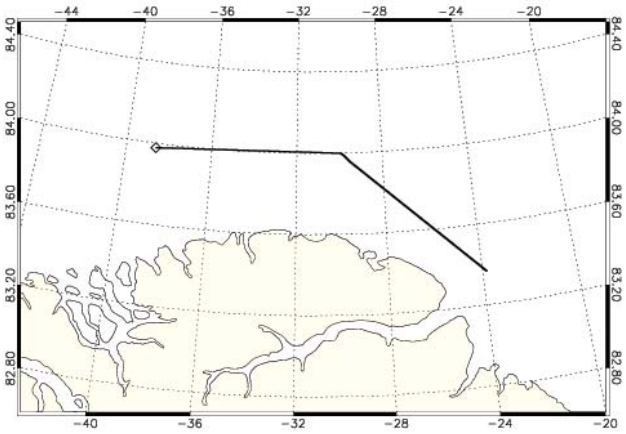


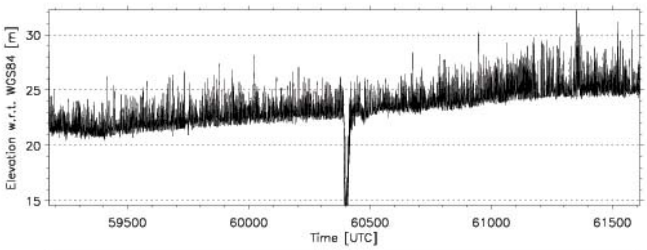


Date	2014−03−29	**Instrument Mode**	Adv. Low Altitude
Start Time	16:26:13 (59173)	**Aircraft**	DNSC Twin Otter
Stop Time	17:06:51 (61611)	**Retracker**	OCOG
Distance	203.444 km	**INS Resolution**	50 Hz
Duration	00 h 40 m 39 s	**Processor Version**	0403

A140329_02

AS3OA02_ASWL1B040320140329T162613_20140329T170652_0001.DBL

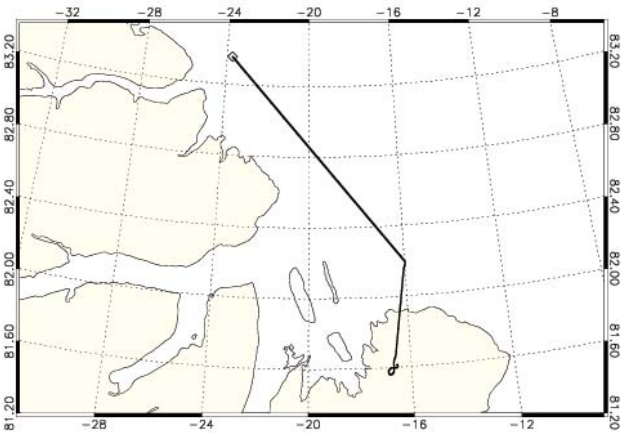


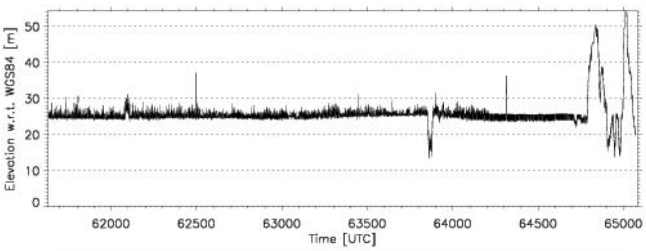


Date	2014−03−29	**Instrument Mode**	Adv. Low Altitude
Start Time	16:26:14 (59174)	**Aircraft**	DNSC Twin Otter
Stop Time	17:06:52 (61612)	**Retracker**	TSRA
Distance	203.429 km	**INS Resolution**	50 Hz
Duration	00 h 40 m 39 s	**Processor Version**	0403

A140329_03

AS3OA03_ASWL1B040320140329T170708_20140329T180445_0001.DBL

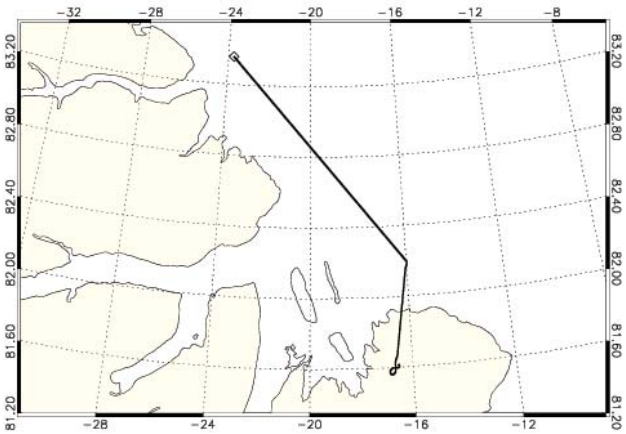


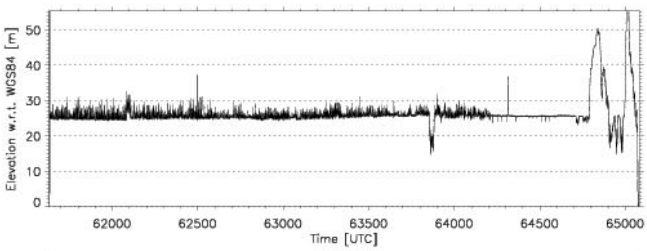


Date	2014−03−29	**Instrument Mode**	Adv. Low Altitude
Start Time	17:07:08 (61628)	**Aircraft**	DNSC Twin Otter
Stop Time	18:04:44 (65084)	**Retracker**	OCOG
Distance	252.804 km	**INS Resolution**	50 Hz
Duration	00 h 57 m 36 s	**Processor Version**	0403

A140329_03

AS3OA03_ASWL1B040320140329T170708_20140329T180445_0001.DBL

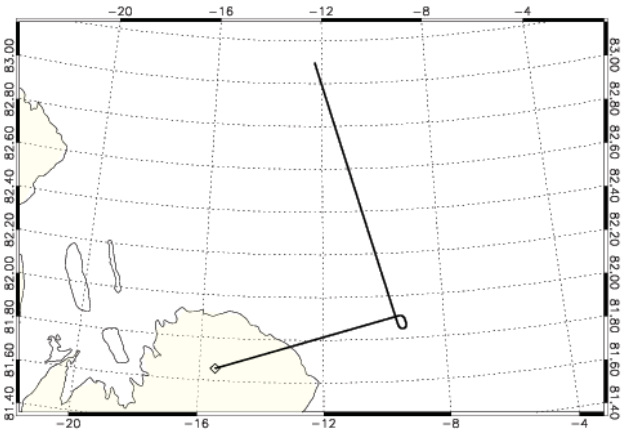


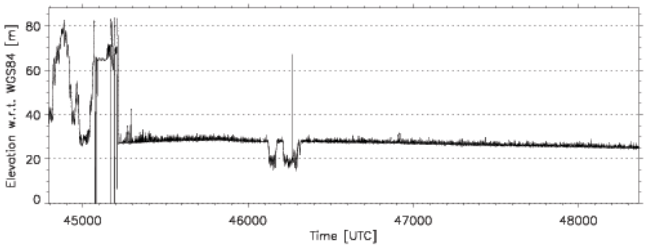


Date	2014−03−29	**Instrument Mode**	Adv. Low Altitude
Start Time	17:07:09 (61629)	**Aircraft**	DNSC Twin Otter
Stop Time	18:04:45 (65085)	**Retracker**	TSRA
Distance	252.787 km	**INS Resolution**	50 Hz
Duration	00 h 57 m 36 s	**Processor Version**	0403

A140330_00

AS3OA00_ASIWL1B0403201403307122633_20140330T132605_0001.DBL

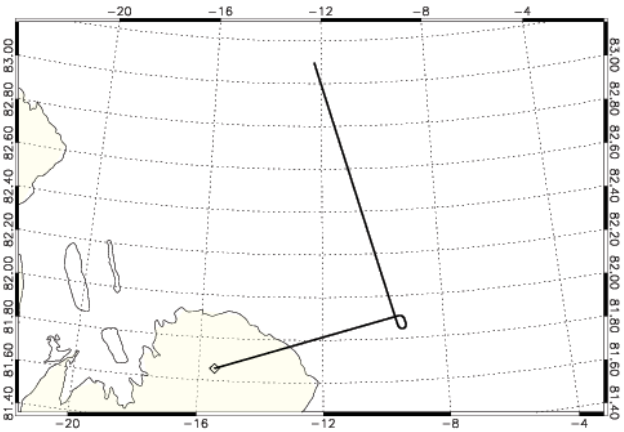


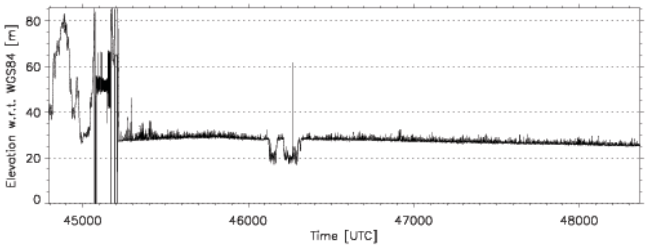


Date	2014−03−30	**Instrument Mode**	Adv. Low Altitude
Start Time	12:26:33 (44793)	**Aircraft**	DNSC Twin Otter
Stop Time	13:26:04 (48364)	**Retracker**	OCOG
Distance	255.526 km	**INS Resolution**	50 Hz
Duration	00 h 59 m 32 s	**Processor Version**	0403

A140330_00

AS3OA00_ASIWL1B0403201403307122633_20140330T132605_0001.DBL

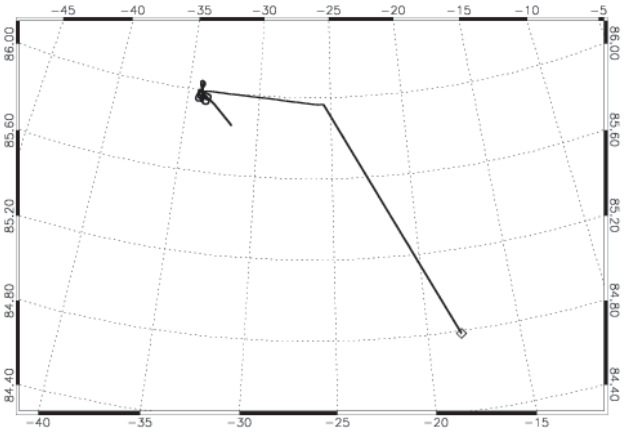


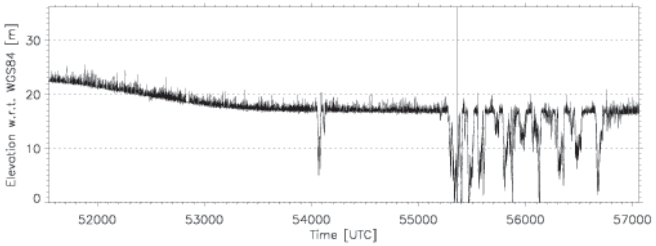


Date	2014−03−30	**Instrument Mode**	Adv. Low Altitude
Start Time	12:26:34 (44794)	**Aircraft**	DNSC Twin Otter
Stop Time	13:26:05 (48365)	**Retracker**	TSRA
Distance	255.593 km	**INS Resolution**	50 Hz
Duration	00 h 59 m 32 s	**Processor Version**	0403

A140330_02

AS3OA02_ASIWL1B0403201403307141903_20140330T155059_0001.DBL

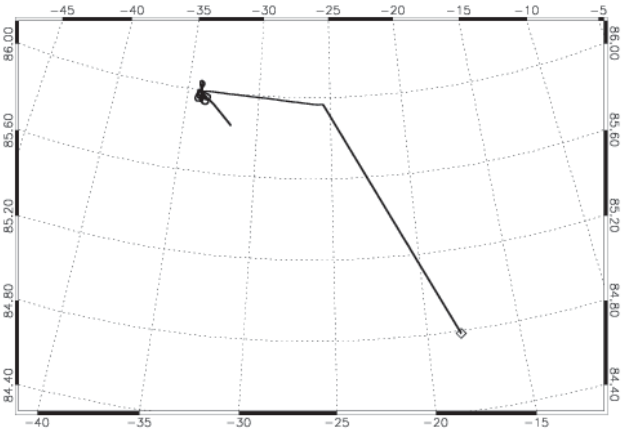


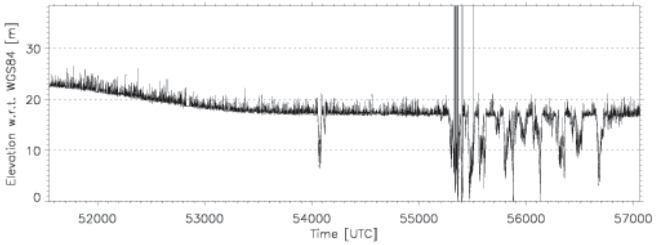


Date	2014−03−30	**Instrument Mode**	Adv. Low Altitude
Start Time	14:19:03 (51543)	**Aircraft**	DNSC Twin Otter
Stop Time	15:50:58 (57058)	**Retracker**	OCOG
Distance	338.849 km	**INS Resolution**	50 Hz
Duration	01 h 31 m 56 s	**Processor Version**	0403

A140330_02

AS3OA02_ASIWL1B0403201403307141903_20140330T155059_0001.DBL

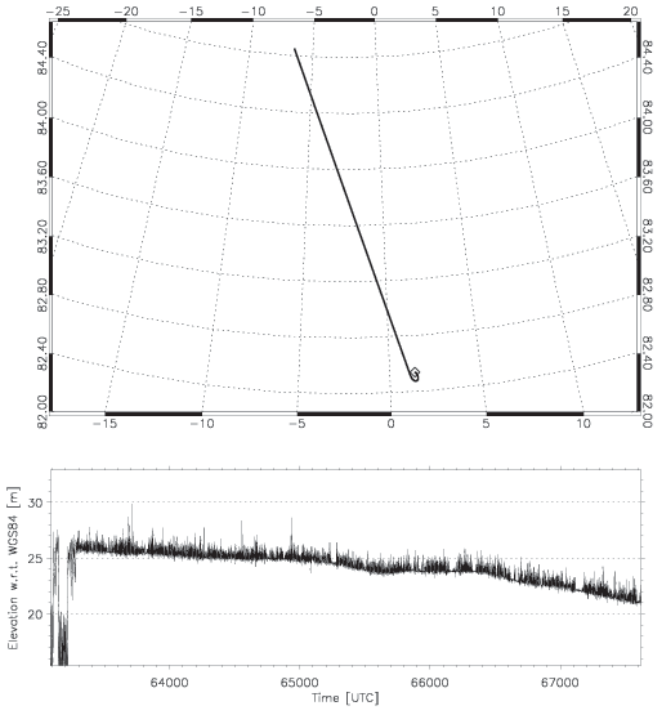




Date	2014−03−30	**Instrument Mode**	Adv. Low Altitude
Start Time	14:19:04 (51544)	**Aircraft**	DNSC Twin Otter
Stop Time	15:50:59 (57059)	**Retracker**	TSRA
Distance	338.837 km	**INS Resolution**	50 Hz
Duration	01 h 31 m 56 s	**Processor Version**	0403

A140331_00

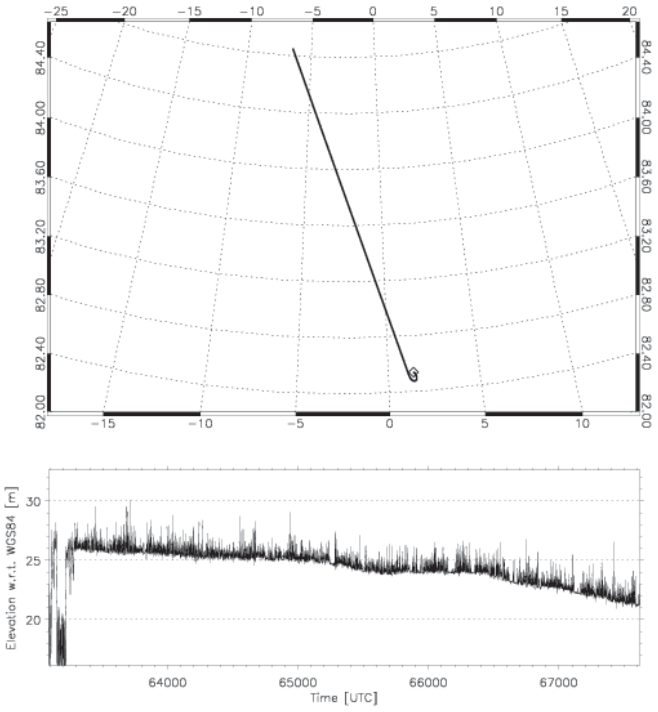
AS30A00_ASWL1804032014033111173125_20140331T184701_0001.DBL



Date	2014-03-31	**Instrument Mode**	Adv. Low Altitude
Start Time	17:31:25 (63085)	**Aircraft**	DNSC Twin Otter
Stop Time	18:47:00 (67620)	**Retracker**	OCOG
Distance	290.042 km	**INS Resolution**	50 Hz
Duration	01 h 15 m 35 s	**Processor Version**	0403

A140331_00

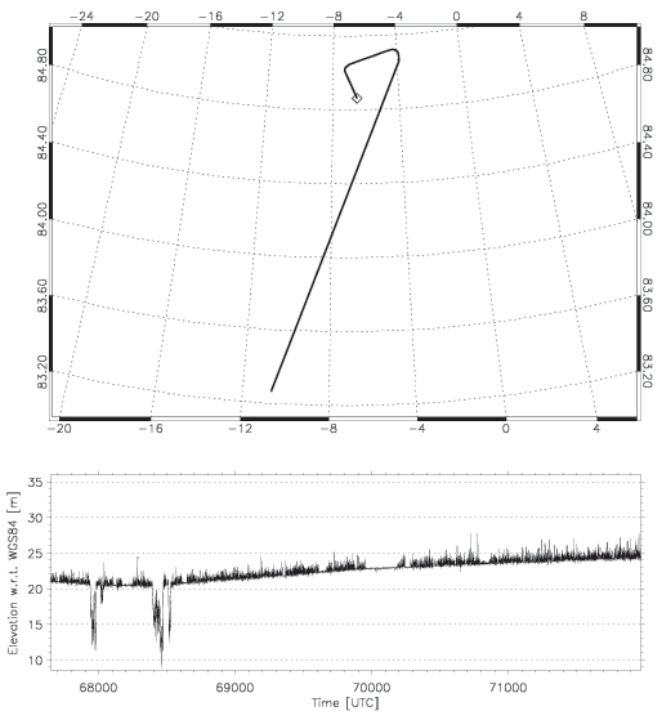
AS30A00_ASWL1804032014033111173125_20140331T184701_0001.DBL



Date	2014-03-31	**Instrument Mode**	Adv. Low Altitude
Start Time	17:31:26 (63086)	**Aircraft**	DNSC Twin Otter
Stop Time	18:47:01 (67621)	**Retracker**	TSRA
Distance	289.766 km	**INS Resolution**	50 Hz
Duration	01 h 15 m 35 s	**Processor Version**	0403

A140331_01

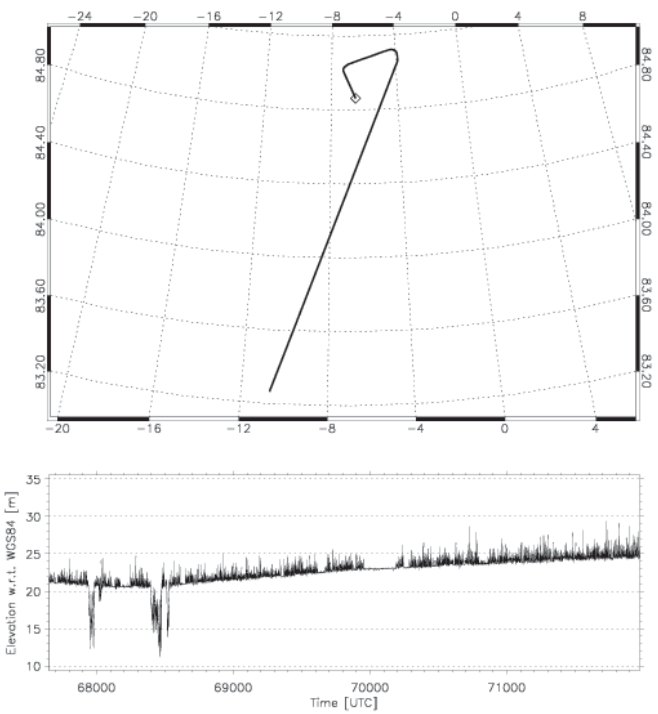
AS30A01_ASWL1804032014033111184728_20140331T195933_0001.DBL



Date	2014-03-31	**Instrument Mode**	Adv. Low Altitude
Start Time	18:47:28 (67648)	**Aircraft**	DNSC Twin Otter
Stop Time	19:59:32 (71972)	**Retracker**	OCOG
Distance	272.882 km	**INS Resolution**	50 Hz
Duration	01 h 12 m 05 s	**Processor Version**	0403

A140331_01

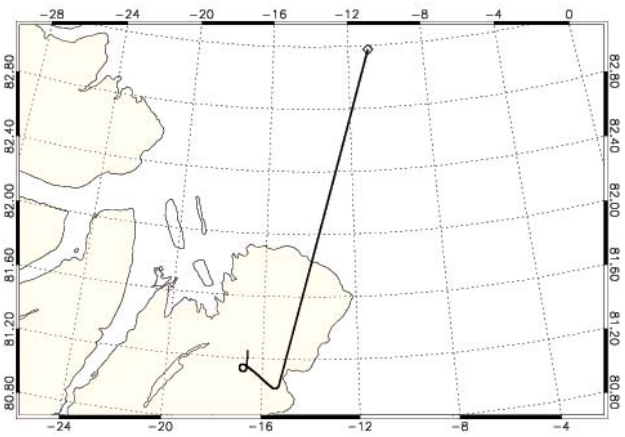
AS30A01_ASWL1804032014033111184728_20140331T195933_0001.DBL

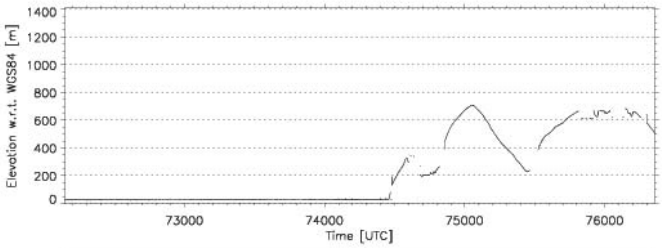


Date	2014-03-31	**Instrument Mode**	Adv. Low Altitude
Start Time	18:47:29 (67649)	**Aircraft**	DNSC Twin Otter
Stop Time	19:59:33 (71973)	**Retracker**	TSRA
Distance	273.032 km	**INS Resolution**	50 Hz
Duration	01 h 12 m 05 s	**Processor Version**	0403

A140331_02

AS3OA02_ASWL180403201403311200224_20140331T211239_0001.DBL

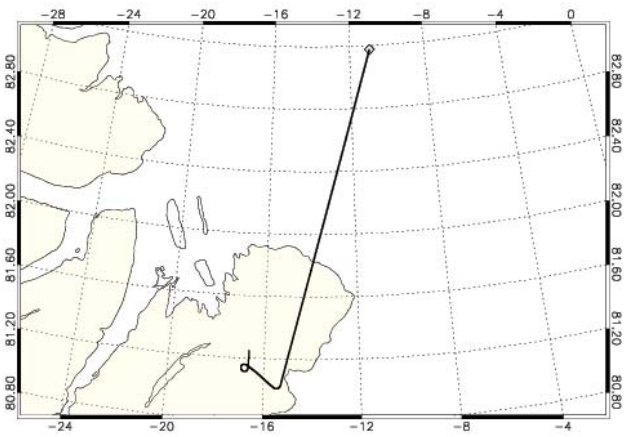


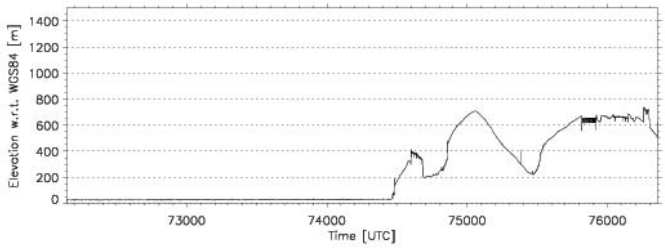


Date	2014-03-31	**Instrument Mode**	Adv. Low Altitude
Start Time	20:02:24 (72144)	**Aircraft**	DNSC Twin Otter
Stop Time	21:12:38 (76358)	**Retracker**	OCOG
Distance	304.714 km	**INS Resolution**	50 Hz
Duration	01 h 10 m 14 s	**Processor Version**	0403

A140331_02

AS3OA02_ASWL180403201403311200224_20140331T211239_0001.DBL

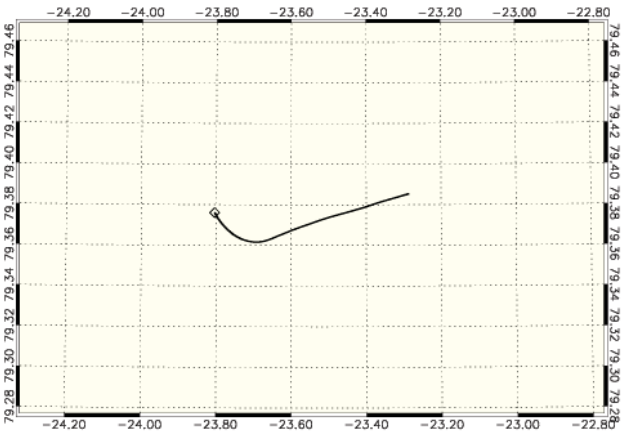


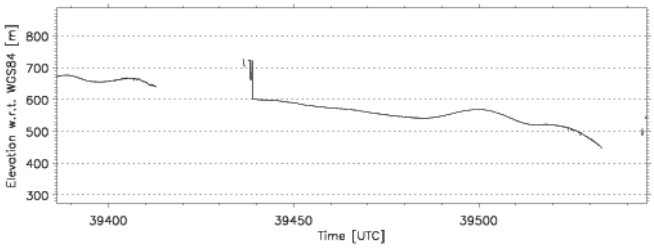


Date	2014-03-31	**Instrument Mode**	Adv. Low Altitude
Start Time	20:02:25 (72145)	**Aircraft**	DNSC Twin Otter
Stop Time	21:12:39 (76359)	**Retracker**	TSRA
Distance	305.018 km	**INS Resolution**	50 Hz
Duration	01 h 10 m 14 s	**Processor Version**	0403

A140401_00

AS3OA00_ASWL180403201404011105626_20140401T113635_0001.DBL

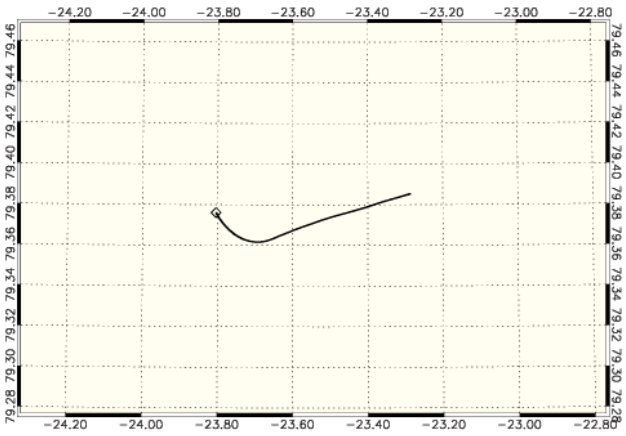


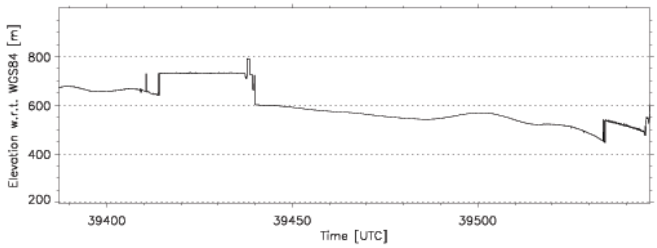


Date	2014-04-01	**Instrument Mode**	Adv. Low Altitude
Start Time	10:56:26 (39386)	**Aircraft**	DNSC Twin Otter
Stop Time	10:59:05 (39545)	**Retracker**	OCOG
Distance	11.735 km	**INS Resolution**	50 Hz
Duration	00 h 02 m 39 s	**Processor Version**	0403

A140401_00

AS3OA00_ASWL180403201404011105626_20140401T113635_0001.DBL

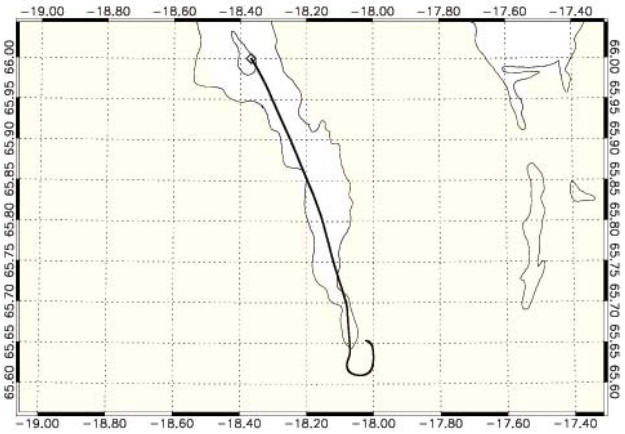


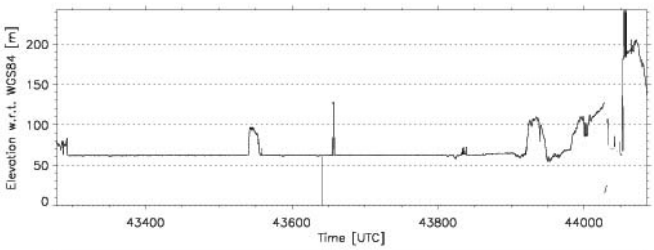


Date	2014-04-01	**Instrument Mode**	Adv. Low Altitude
Start Time	10:56:27 (39387)	**Aircraft**	DNSC Twin Otter
Stop Time	10:59:06 (39546)	**Retracker**	TSRA
Distance	11.735 km	**INS Resolution**	50 Hz
Duration	00 h 02 m 39 s	**Processor Version**	0403

A140428_00

AS30A00_ASWL180403201404281120118_20140428T121446_0001.DBL

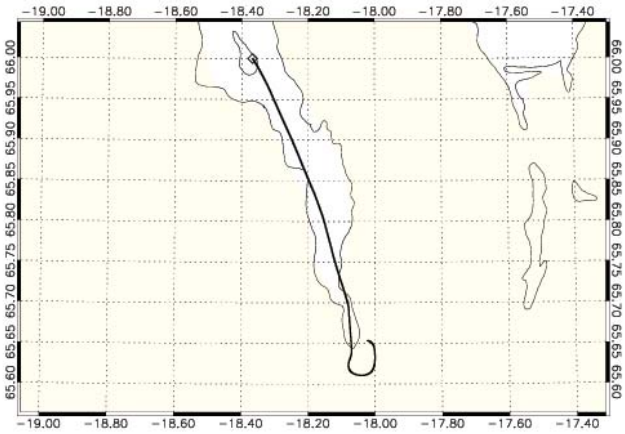


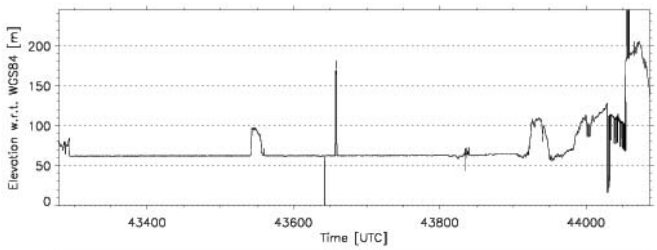


Date	2014-04-28	**Instrument Mode**	Adv. Low Altitude
Start Time	12:01:18 (43278)	**Aircraft**	DNSC Twin Otter
Stop Time	12:14:45 (44085)	**Retracker**	OCOG
Distance	53.510 km	**INS Resolution**	50 Hz
Duration	00 h 13 m 28 s	**Processor Version**	0403

A140428_00

AS30A00_ASWL180403201404281120118_20140428T121446_0001.DBL

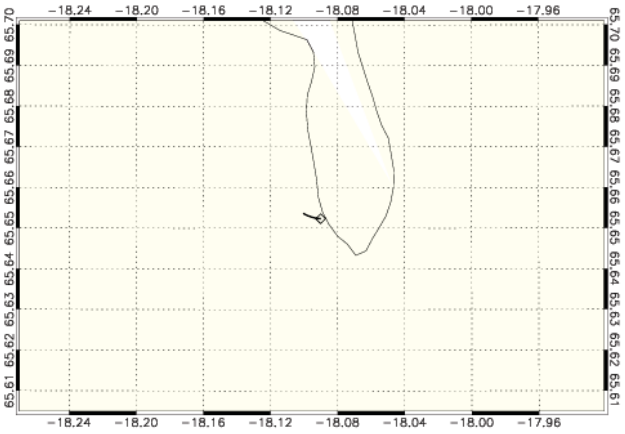


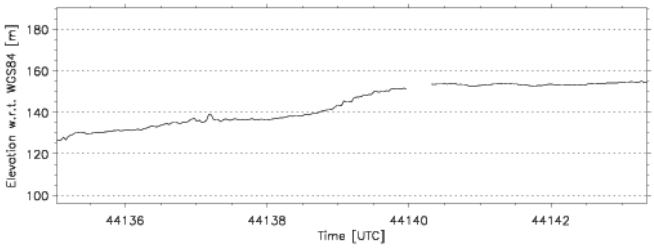


Date	2014-04-28	**Instrument Mode**	Adv. Low Altitude
Start Time	12:01:19 (43279)	**Aircraft**	DNSC Twin Otter
Stop Time	12:14:46 (44086)	**Retracker**	TSRA
Distance	53.512 km	**INS Resolution**	50 Hz
Duration	00 h 13 m 28 s	**Processor Version**	0403

A140428_01

AS30A01_ASWL180403201404281121535_20140428T121544_0001.DBL

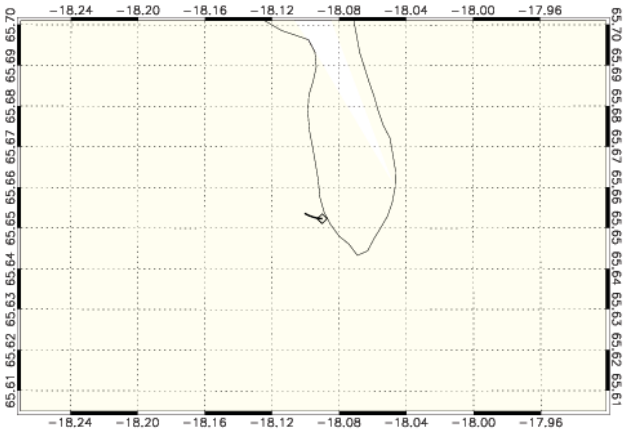


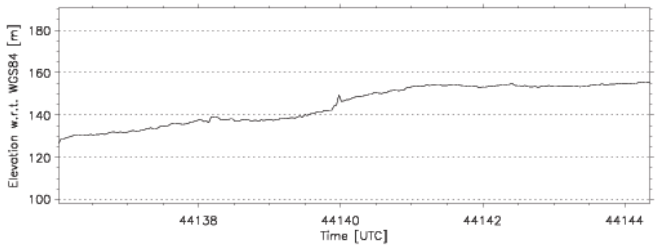


Date	2014-04-28	**Instrument Mode**	Adv. Low Altitude
Start Time	12:15:35 (44135)	**Aircraft**	DNSC Twin Otter
Stop Time	12:15:43 (44143)	**Retracker**	OCOG
Distance	0.504 km	**INS Resolution**	50 Hz
Duration	00 h 00 m 08 s	**Processor Version**	0403

A140428_01

AS30A01_ASWL180403201404281121535_20140428T121544_0001.DBL

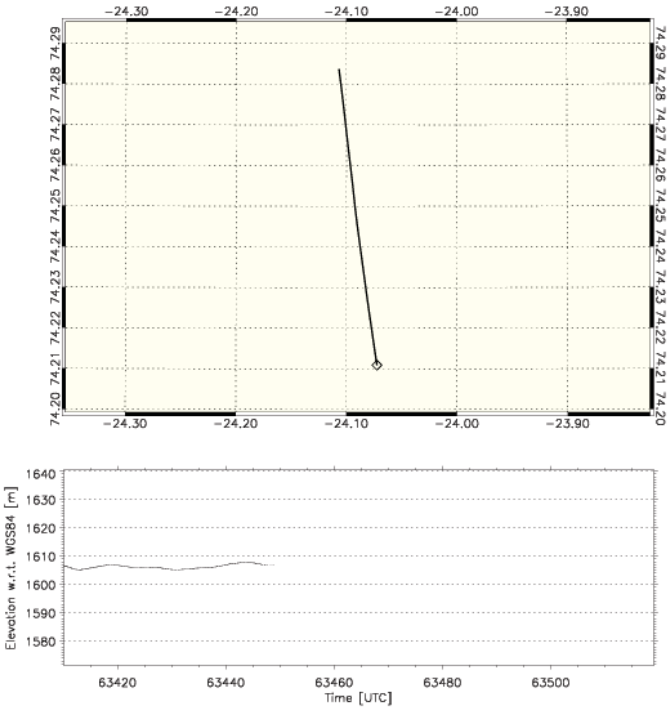




Date	2014-04-28	**Instrument Mode**	Adv. Low Altitude
Start Time	12:15:36 (44136)	**Aircraft**	DNSC Twin Otter
Stop Time	12:15:44 (44144)	**Retracker**	TSRA
Distance	0.504 km	**INS Resolution**	50 Hz
Duration	00 h 00 m 08 s	**Processor Version**	0403

A140428_05

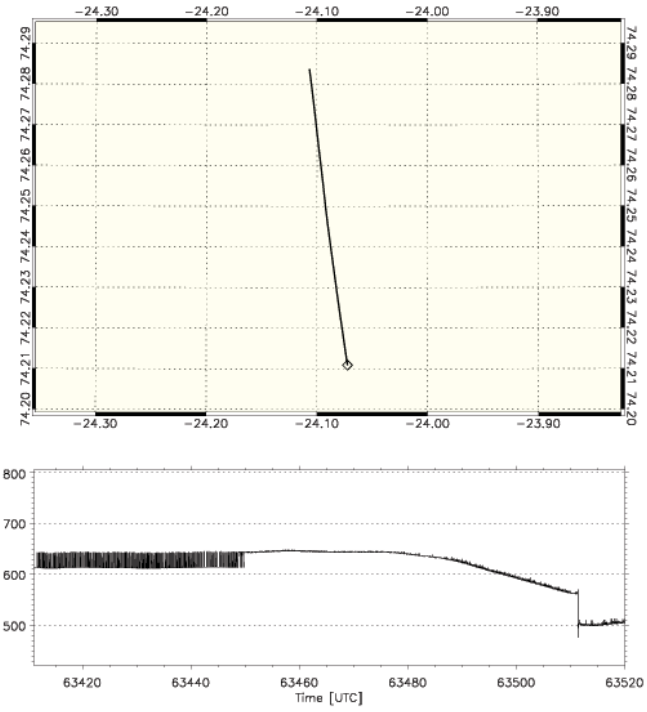
AS30A05_ASWL1B0403201404281T173650_20140428T173839_0001.DBL



Date	2014−04−28	**Instrument Mode**	Adv. Low Altitude
Start Time	17:36:50 (63410)	**Aircraft**	DNSC Twin Otter
Stop Time	17:38:39 (63519)	**Retracker**	OCOG
Distance	8.153 km	**INS Resolution**	50 Hz
Duration	00 h 01 m 49 s	**Processor Version**	0403

A140428_05

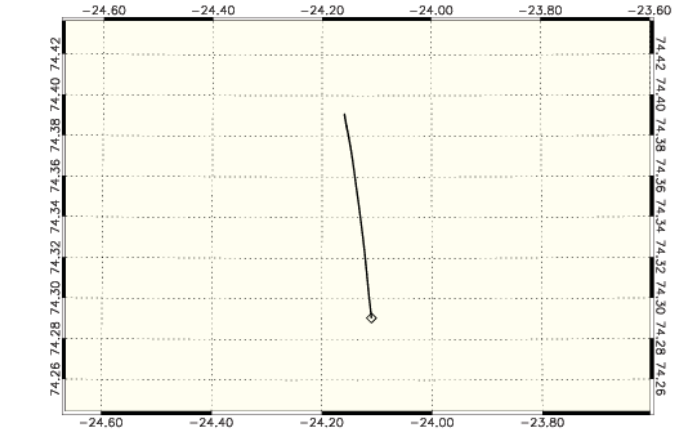
AS30A05_ASWL1B0403201404281T173650_20140428T173839_0001.DBL

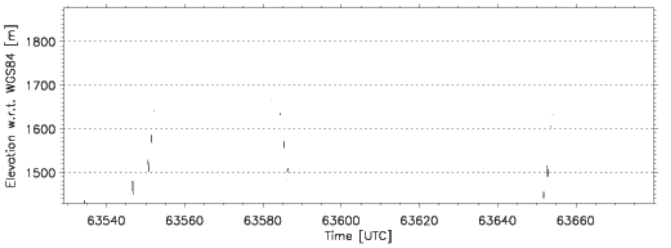


Date	2014−04−28	**Instrument Mode**	Adv. Low Altitude
Start Time	17:36:51 (63411)	**Aircraft**	DNSC Twin Otter
Stop Time	17:38:40 (63520)	**Retracker**	TSRA
Distance	8.153 km	**INS Resolution**	50 Hz
Duration	00 h 01 m 49 s	**Processor Version**	0403

A140428_06

AS30A06_ASWL1B0403201404281T173849_20140428T174120_0001.DBL

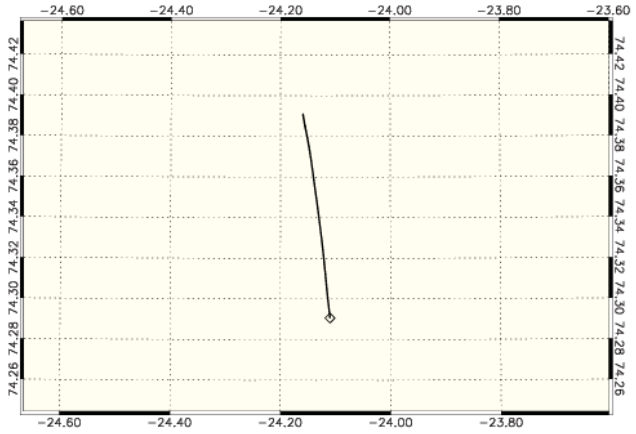


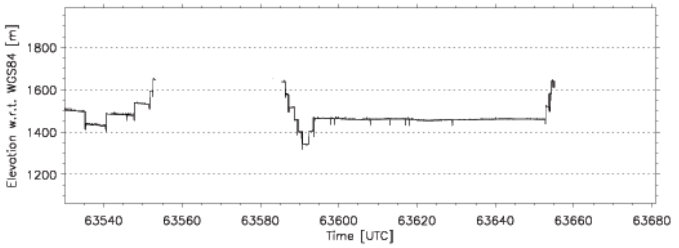


Date	2014−04−28	**Instrument Mode**	Adv. Low Altitude
Start Time	17:38:49 (63529)	**Aircraft**	DNSC Twin Otter
Stop Time	17:41:19 (63679)	**Retracker**	OCOG
Distance	11.290 km	**INS Resolution**	50 Hz
Duration	00 h 02 m 31 s	**Processor Version**	0403

A140428_06

AS30A06_ASWL1B0403201404281T173849_20140428T174120_0001.DBL

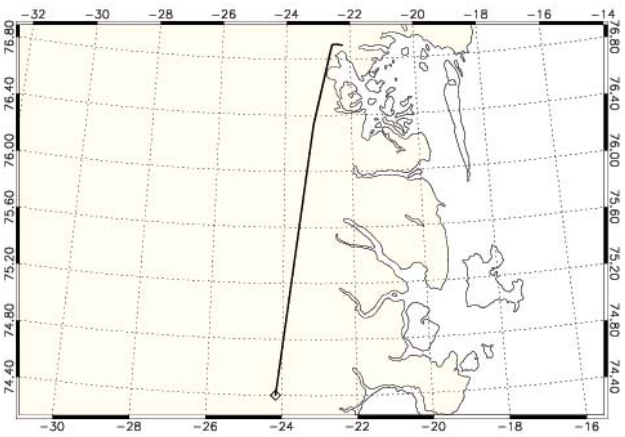


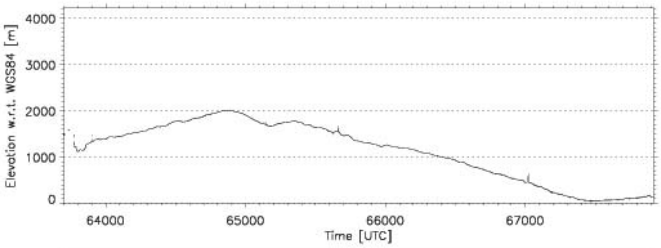


Date	2014−04−28	**Instrument Mode**	Adv. Low Altitude
Start Time	17:38:50 (63530)	**Aircraft**	DNSC Twin Otter
Stop Time	17:41:20 (63680)	**Retracker**	TSRA
Distance	11.290 km	**INS Resolution**	50 Hz
Duration	00 h 02 m 31 s	**Processor Version**	0403

A140428_07

AS3OA07_ASWL1804032014042811741 39_20140428T185201_0001.DBL

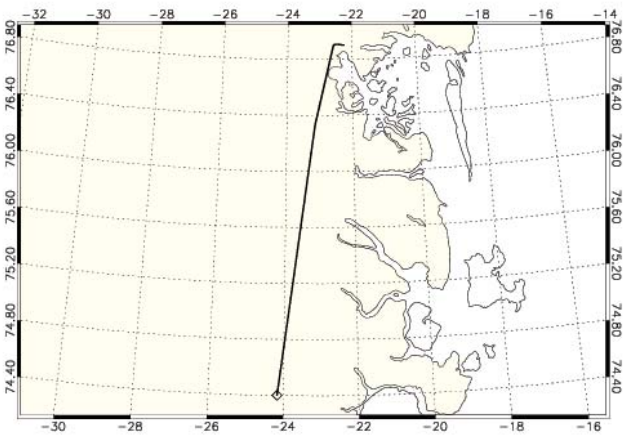


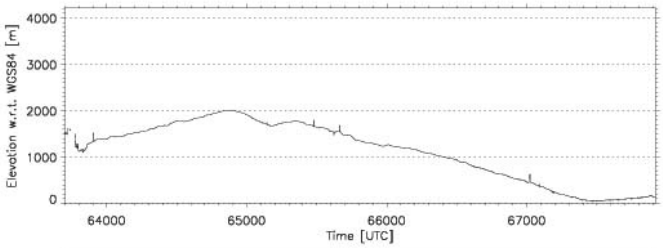


Date	2014−04−28	**Instrument Mode**	Adv. Low Altitude
Start Time	17:41:39 (63699)	**Aircraft**	DNSC Twin Otter
Stop Time	18:52:00 (67920)	**Retracker**	OCOG
Distance	290.128 km	**INS Resolution**	50 Hz
Duration	01 h 10 m 22 s	**Processor Version**	0403

A140428_07

AS3OA07_ASWL1804032014042811741 39_20140428T185201_0001.DBL

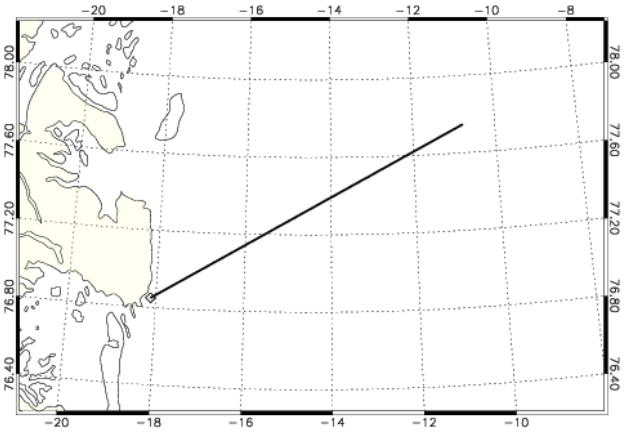


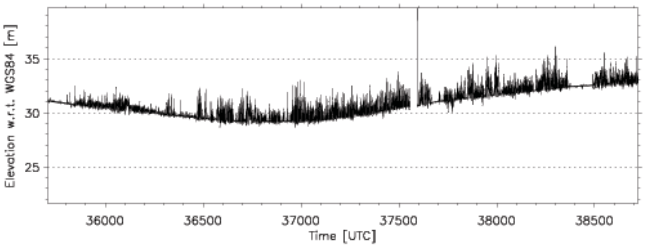


Date	2014−04−28	**Instrument Mode**	Adv. Low Altitude
Start Time	17:41:40 (63700)	**Aircraft**	DNSC Twin Otter
Stop Time	18:52:01 (67921)	**Retracker**	TSRA
Distance	290.454 km	**INS Resolution**	50 Hz
Duration	01 h 10 m 22 s	**Processor Version**	0403

A140429_00

AS3OA00_ASWL1804032014042907 9506_20140429T104522_0001.DBL

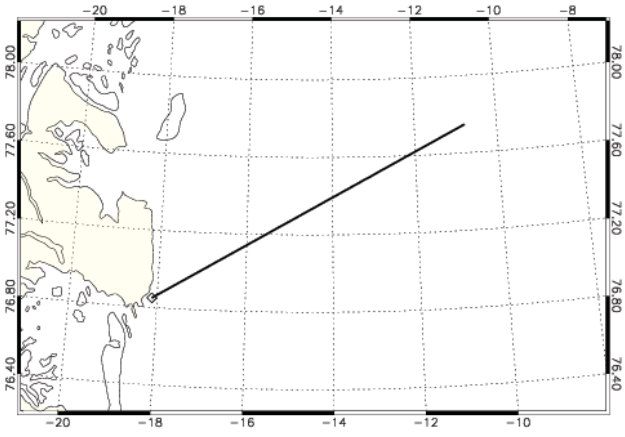


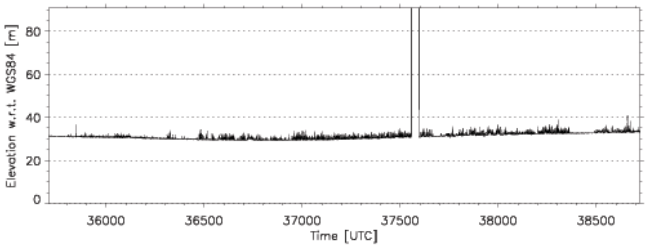


Date	2014−04−29	**Instrument Mode**	Adv. Low Altitude
Start Time	09:55:06 (35706)	**Aircraft**	DNSC Twin Otter
Stop Time	10:45:21 (38721)	**Retracker**	OCOG
Distance	204.689 km	**INS Resolution**	50 Hz
Duration	00 h 50 m 16 s	**Processor Version**	0403

A140429_00

AS3OA00_ASWL1804032014042907 9506_20140429T104522_0001.DBL

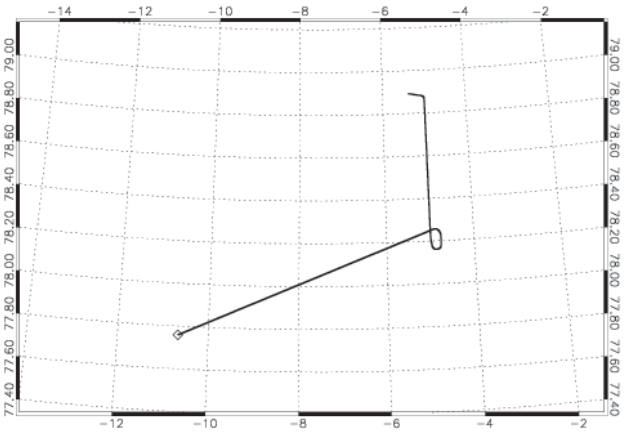


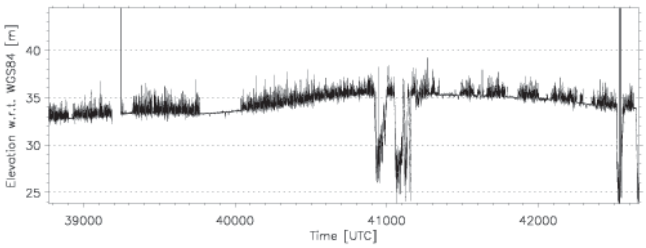


Date	2014−04−29	**Instrument Mode**	Adv. Low Altitude
Start Time	09:55:07 (35707)	**Aircraft**	DNSC Twin Otter
Stop Time	10:45:22 (38722)	**Retracker**	TSRA
Distance	204.634 km	**INS Resolution**	50 Hz
Duration	00 h 50 m 16 s	**Processor Version**	0403

A140429_01

AS30A01_ASWL1B0403201404291104609_20140429T115104_0001.DBL

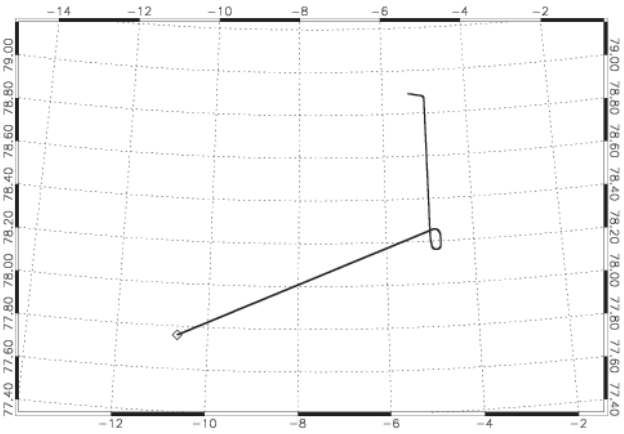


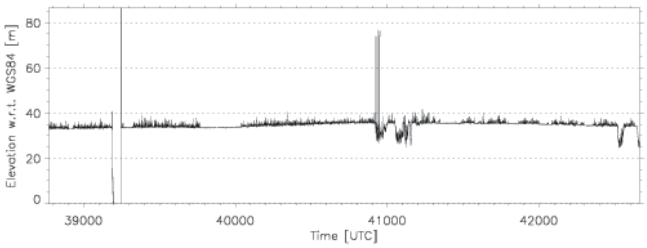


Date	2014-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	10:46:09 (38769)	**Aircraft**	DNSC Twin Otter
Stop Time	11:51:03 (42663)	**Retracker**	OCOG
Distance	247.346 km	**INS Resolution**	50 Hz
Duration	01 h 04 m 55 s	**Processor Version**	0403

A140429_01

AS30A01_ASWL1B0403201404291104609_20140429T115104_0001.DBL

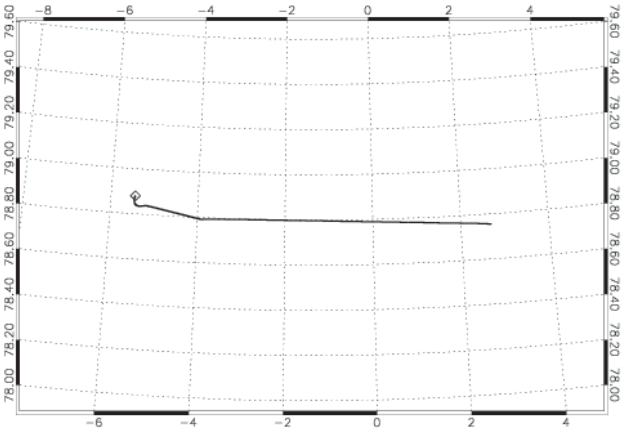


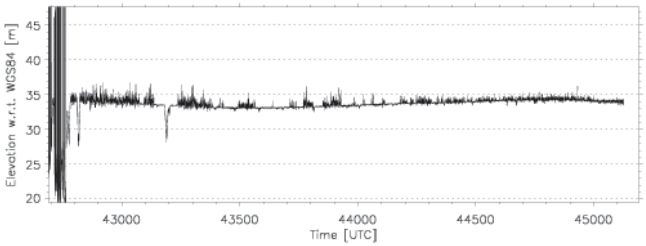


Date	2014-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	10:46:10 (38770)	**Aircraft**	DNSC Twin Otter
Stop Time	11:51:04 (42664)	**Retracker**	TSRA
Distance	247.410 km	**INS Resolution**	50 Hz
Duration	01 h 04 m 55 s	**Processor Version**	0403

A140429_02

AS30A02_ASWL1B0403201404291115130_20140429T123312_0001.DBL

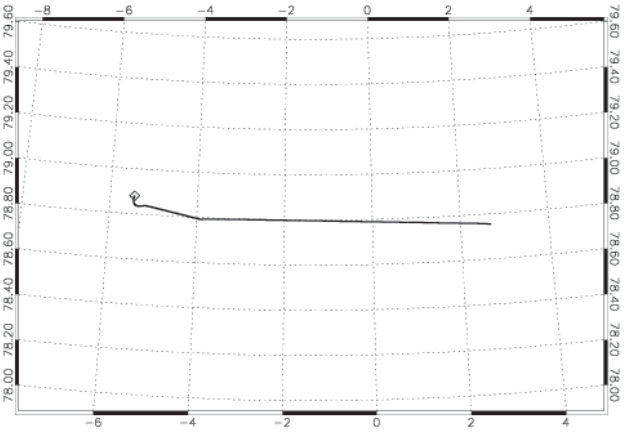


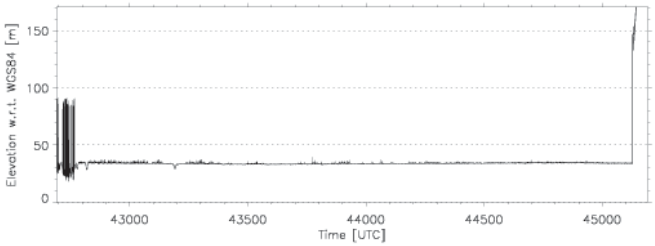


Date	2014-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	11:51:30 (42690)	**Aircraft**	DNSC Twin Otter
Stop Time	12:33:11 (45191)	**Retracker**	OCOG
Distance	181.060 km	**INS Resolution**	50 Hz
Duration	00 h 41 m 42 s	**Processor Version**	0403

A140429_02

AS30A02_ASWL1B0403201404291115130_20140429T123312_0001.DBL

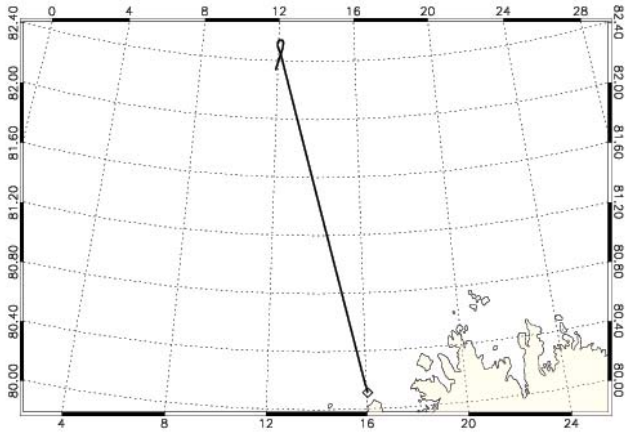


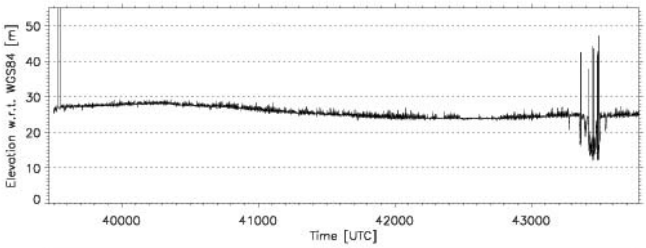


Date	2014-04-29	**Instrument Mode**	Adv. Low Altitude
Start Time	11:51:31 (42691)	**Aircraft**	DNSC Twin Otter
Stop Time	12:33:12 (45192)	**Retracker**	TSRA
Distance	181.060 km	**INS Resolution**	50 Hz
Duration	00 h 41 m 42 s	**Processor Version**	0403

A140502_00

AS3OA00_ASWL1804032014050 2T105745_20140502T120948_0001.DBL

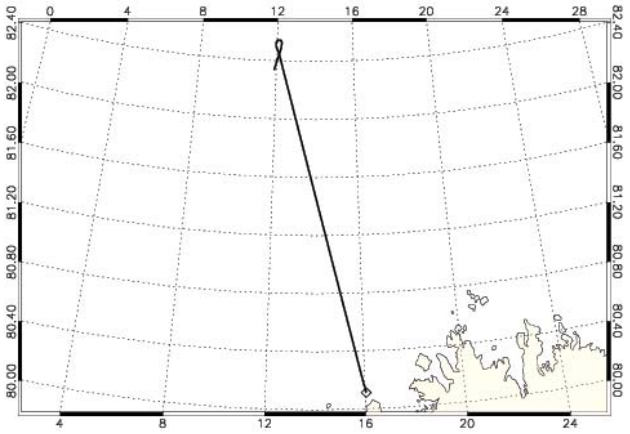


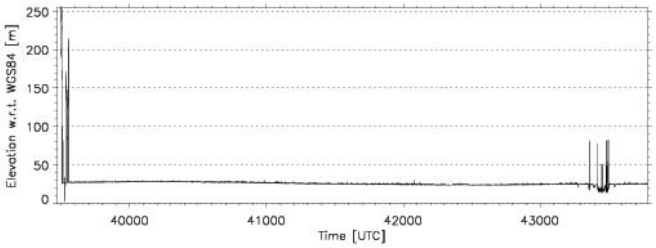


Date	2014-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	10:57:45 (39465)	**Aircraft**	DNSC Twin Otter
Stop Time	12:09:47 (43787)	**Retracker**	OCOG
Distance	304.828 km	**INS Resolution**	50 Hz
Duration	01 h 12 m 03 s	**Processor Version**	0403

A140502_00

AS3OA00_ASWL1804032014050 2T105745_20140502T120948_0001.DBL

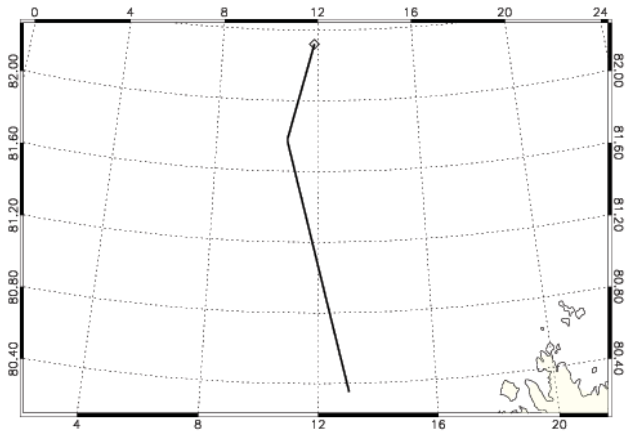


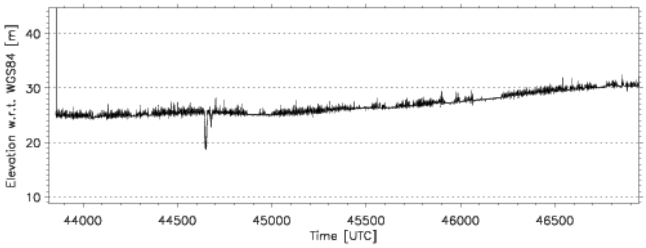


Date	2014-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	10:57:46 (39466)	**Aircraft**	DNSC Twin Otter
Stop Time	12:09:48 (43788)	**Retracker**	TSRA
Distance	305.186 km	**INS Resolution**	50 Hz
Duration	01 h 12 m 03 s	**Processor Version**	0403

A140502_01

AS3OA01_ASWL1804032014050 2T121017_20140502T130225_0001.DBL

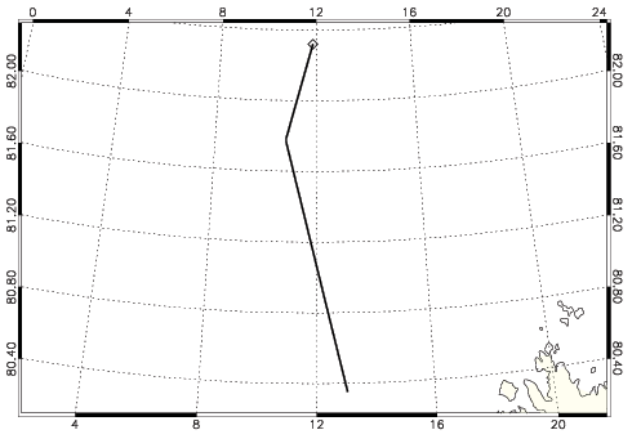


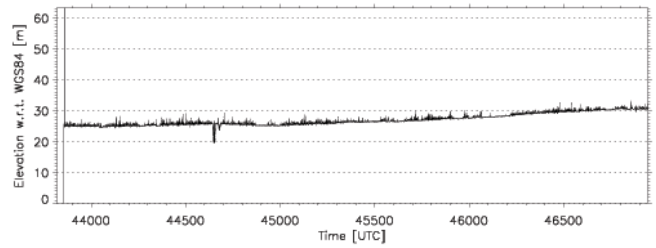


Date	2014-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	12:10:17 (43817)	**Aircraft**	DNSC Twin Otter
Stop Time	13:02:24 (46944)	**Retracker**	OCOG
Distance	225.517 km	**INS Resolution**	50 Hz
Duration	00 h 52 m 08 s	**Processor Version**	0403

A140502_01

AS3OA01_ASWL1804032014050 2T121017_20140502T130225_0001.DBL

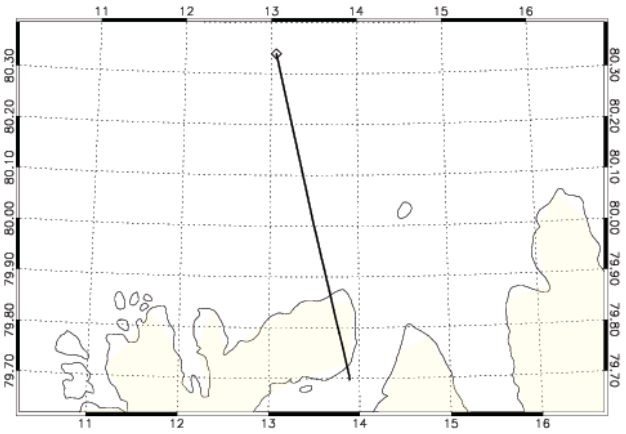


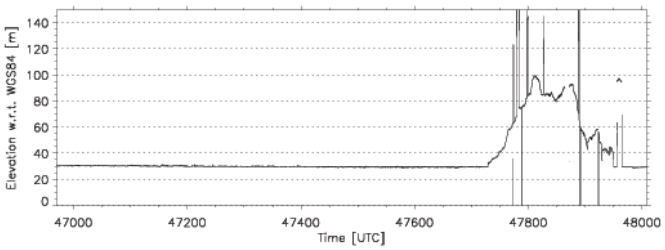


Date	2014-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	12:10:18 (43818)	**Aircraft**	DNSC Twin Otter
Stop Time	13:02:25 (46945)	**Retracker**	TSRA
Distance	225.675 km	**INS Resolution**	50 Hz
Duration	00 h 52 m 08 s	**Processor Version**	0403

A140502_02

AS30A02_ASWL1804032014050211302 50_20140502T132009_0001.DBL

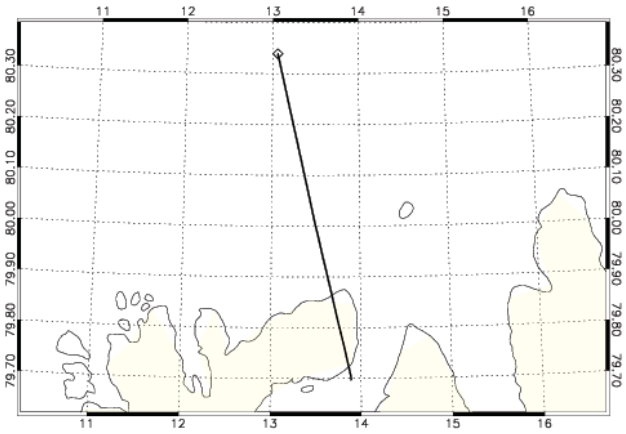


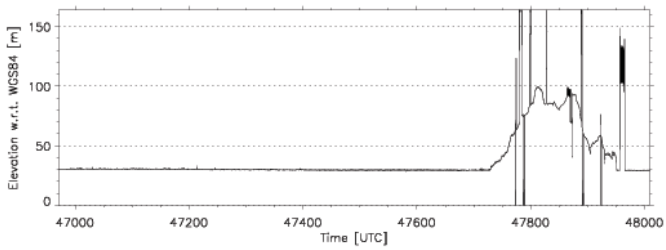


Date	2014-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	13:02:50 (46970)	**Aircraft**	DNSC Twin Otter
Stop Time	13:20:08 (48008)	**Retracker**	OCOG
Distance	73.076 km	**INS Resolution**	50 Hz
Duration	00 h 17 m 18 s	**Processor Version**	0403

A140502_02

AS30A02_ASWL1804032014050211302 50_20140502T132009_0001.DBL

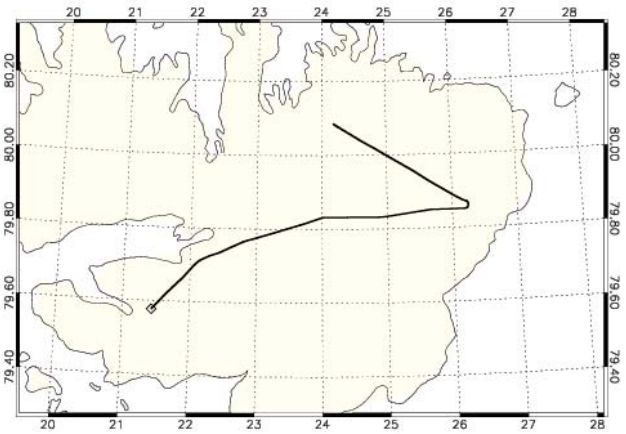


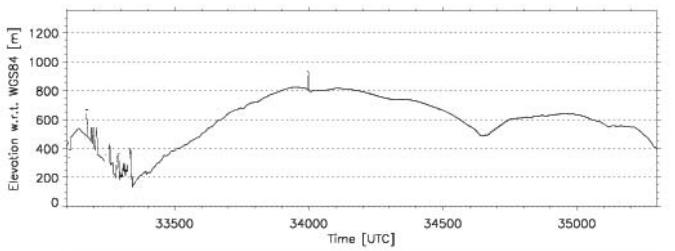


Date	2014-05-02	**Instrument Mode**	Adv. Low Altitude
Start Time	13:02:51 (46971)	**Aircraft**	DNSC Twin Otter
Stop Time	13:20:09 (48009)	**Retracker**	TSRA
Distance	73.068 km	**INS Resolution**	50 Hz
Duration	00 h 17 m 18 s	**Processor Version**	0403

A140503_00

AS30A00_ASWL1804032014050310911 37_20140503T094818_0001.DBL

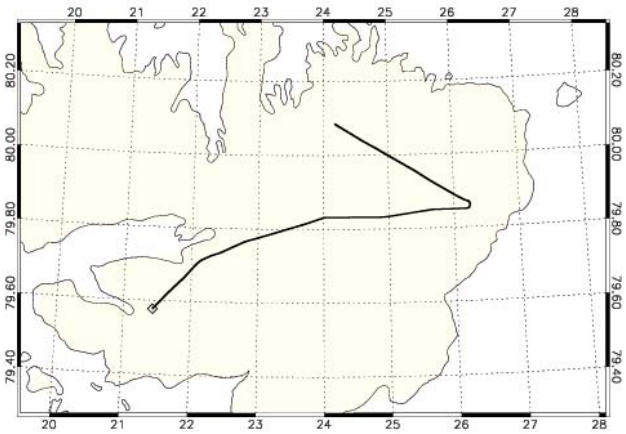


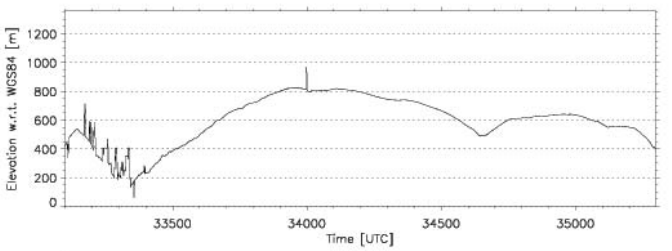


Date	2014-05-03	**Instrument Mode**	Adv. Low Altitude
Start Time	09:11:37 (33097)	**Aircraft**	DNSC Twin Otter
Stop Time	09:48:17 (35297)	**Retracker**	OCOG
Distance	151.951 km	**INS Resolution**	50 Hz
Duration	00 h 36 m 41 s	**Processor Version**	0403

A140503_00

AS30A00_ASWL1804032014050310911 37_20140503T094818_0001.DBL

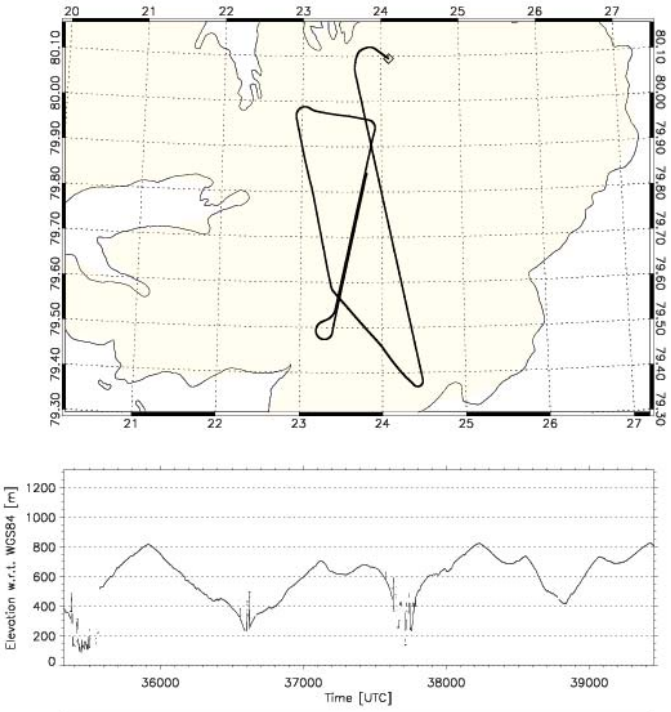




Date	2014-05-03	**Instrument Mode**	Adv. Low Altitude
Start Time	09:11:38 (33098)	**Aircraft**	DNSC Twin Otter
Stop Time	09:48:18 (35298)	**Retracker**	TSRA
Distance	151.942 km	**INS Resolution**	50 Hz
Duration	00 h 36 m 41 s	**Processor Version**	0403

A140503_01

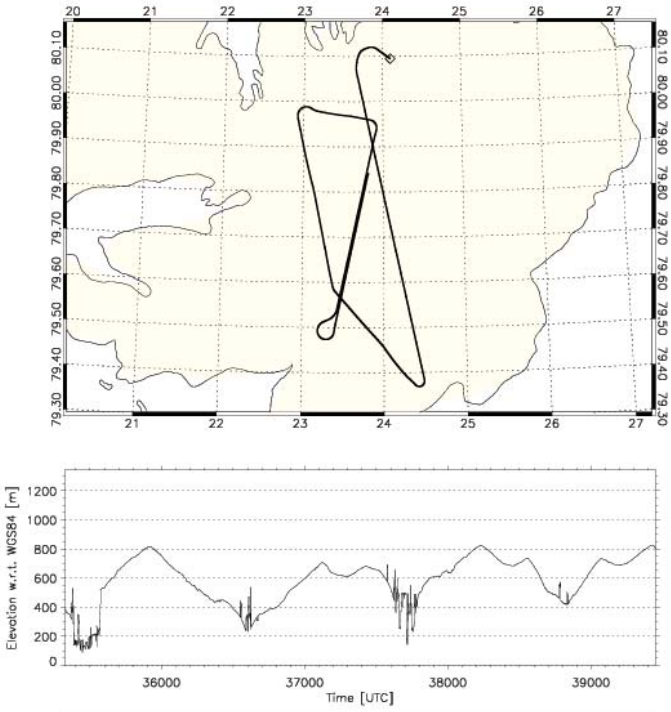
AS3OA01_ASWL1804032014050 3T094842_20140503T105732_0001.DBL



Date	2014-05-03	**Instrument Mode**	Adv. Low Altitude
Start Time	09:48:42 (35322)	**Aircraft**	DNSC Twin Otter
Stop Time	10:57:31 (39451)	**Retracker**	OCOG
Distance	290.711 km	**INS Resolution**	50 Hz
Duration	01 h 08 m 49 s	**Processor Version**	0403

A140503_01

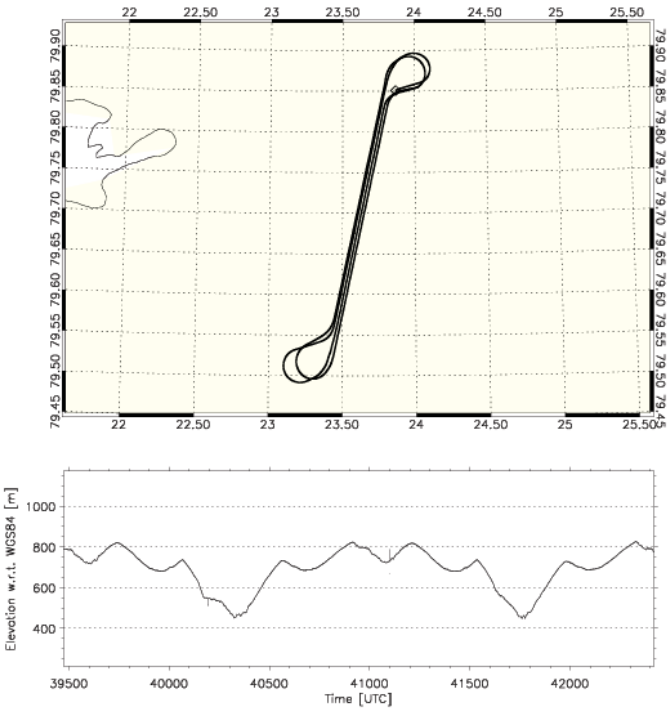
AS3OA01_ASWL1804032014050 3T094842_20140503T105732_0001.DBL



Date	2014-05-03	**Instrument Mode**	Adv. Low Altitude
Start Time	09:48:43 (35323)	**Aircraft**	DNSC Twin Otter
Stop Time	10:57:32 (39452)	**Retracker**	TSRA
Distance	290.694 km	**INS Resolution**	50 Hz
Duration	01 h 08 m 49 s	**Processor Version**	0403

A140503_02

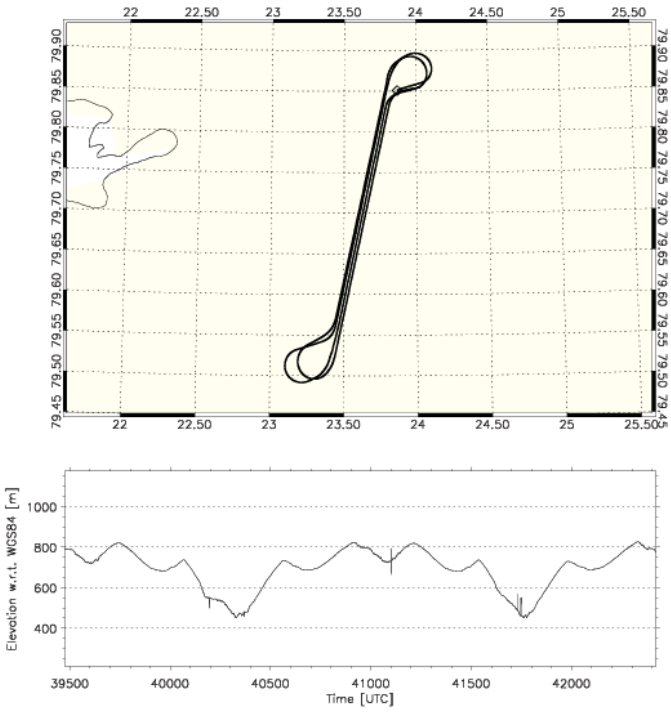
AS3OA02_ASWL1804032014050 3T105753_20140503T114659_0001.DBL



Date	2014-05-03	**Instrument Mode**	Adv. Low Altitude
Start Time	10:57:53 (39473)	**Aircraft**	DNSC Twin Otter
Stop Time	11:46:58 (42418)	**Retracker**	OCOG
Distance	209.394 km	**INS Resolution**	50 Hz
Duration	00 h 49 m 06 s	**Processor Version**	0403

A140503_02

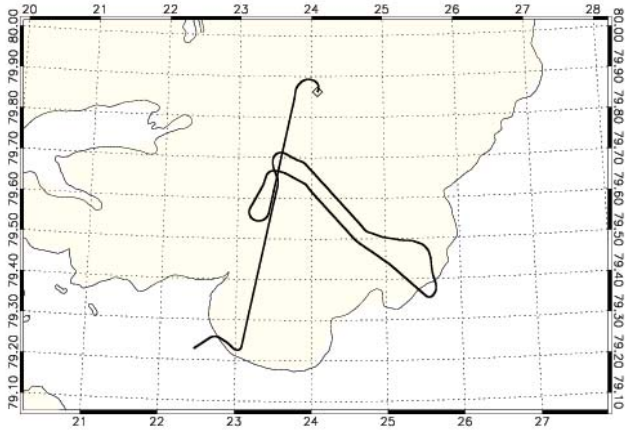
AS3OA02_ASWL1804032014050 3T105753_20140503T114659_0001.DBL

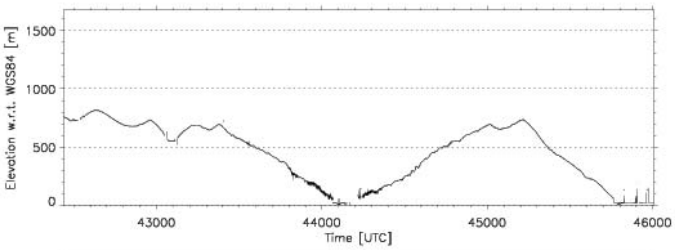


Date	2014-05-03	**Instrument Mode**	Adv. Low Altitude
Start Time	10:57:54 (39474)	**Aircraft**	DNSC Twin Otter
Stop Time	11:46:59 (42419)	**Retracker**	TSRA
Distance	209.387 km	**INS Resolution**	50 Hz
Duration	00 h 49 m 06 s	**Processor Version**	0403

A140503_03

AS30A03_ASWL180403201405031114718_20140503T124648_0001.DBL

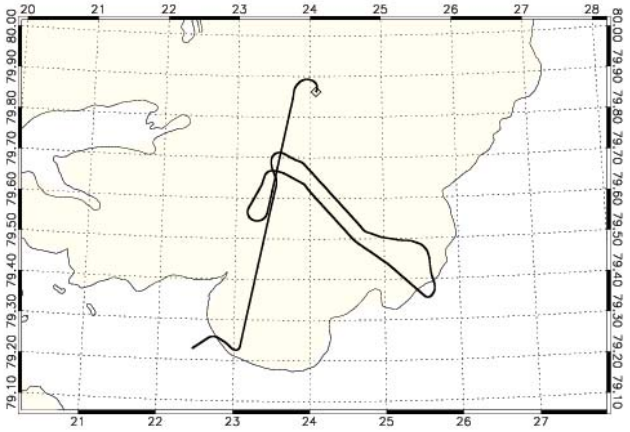


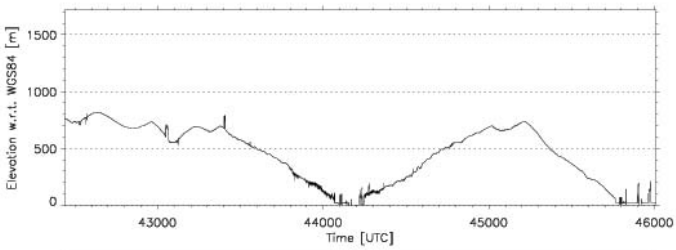


Date	2014-05-03	**Instrument Mode**	Adv. Low Altitude
Start Time	11:47:18 (42438)	**Aircraft**	DNSC Twin Otter
Stop Time	12:46:47 (46007)	**Retracker**	OCOG
Distance	257.005 km	**INS Resolution**	50 Hz
Duration	00 h 59 m 29 s	**Processor Version**	0403

A140503_03

AS30A03_ASWL180403201405031114718_20140503T124648_0001.DBL

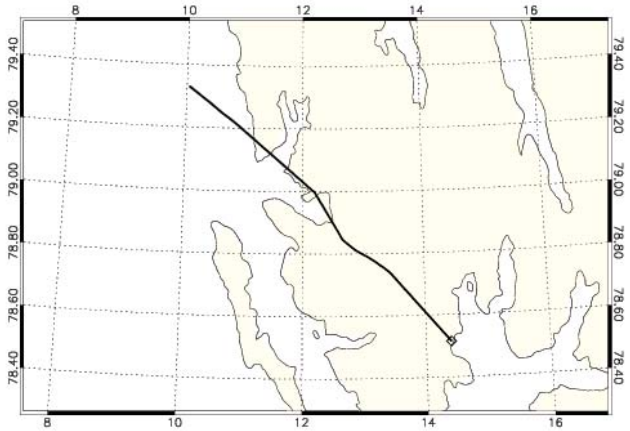


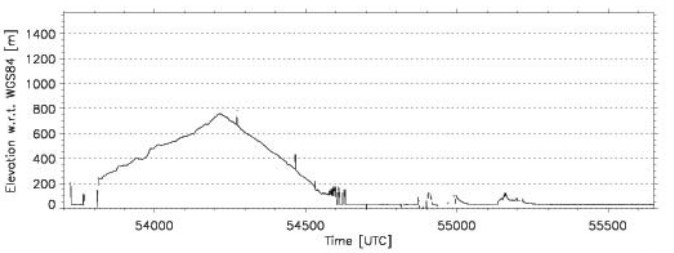


Date	2014-05-03	**Instrument Mode**	Adv. Low Altitude
Start Time	11:47:19 (42439)	**Aircraft**	DNSC Twin Otter
Stop Time	12:46:48 (46008)	**Retracker**	TSRA
Distance	256.997 km	**INS Resolution**	50 Hz
Duration	00 h 59 m 29 s	**Processor Version**	0403

A140503_04

AS30A04_ASWL180403201405031145459_20140503T152732_0001.DBL

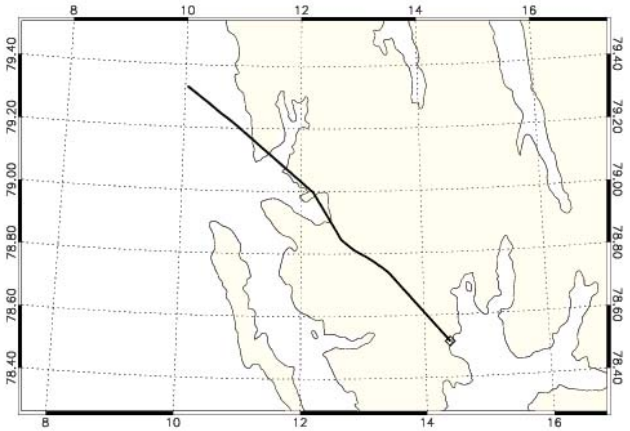


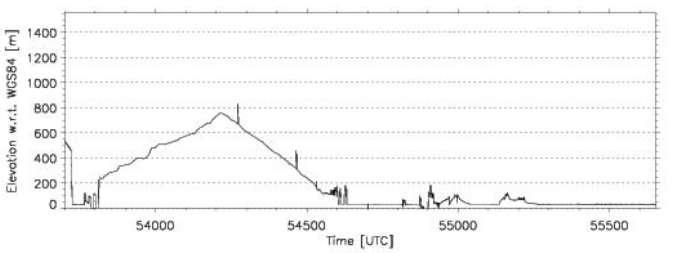


Date	2014-05-03	**Instrument Mode**	Adv. Low Altitude
Start Time	14:54:59 (53699)	**Aircraft**	DNSC Twin Otter
Stop Time	15:27:31 (55651)	**Retracker**	OCOG
Distance	131.229 km	**INS Resolution**	50 Hz
Duration	00 h 32 m 33 s	**Processor Version**	0403

A140503_04

AS30A04_ASWL180403201405031145459_20140503T152732_0001.DBL

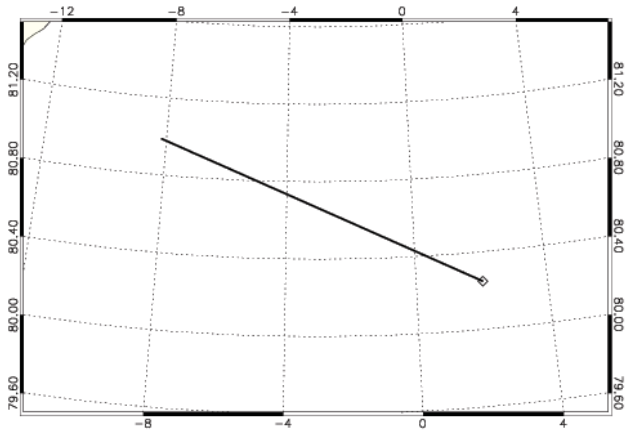


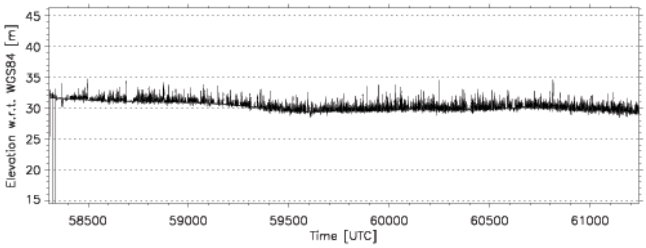


Date	2014-05-03	**Instrument Mode**	Adv. Low Altitude
Start Time	14:55:00 (53700)	**Aircraft**	DNSC Twin Otter
Stop Time	15:27:32 (55652)	**Retracker**	TSRA
Distance	131.261 km	**INS Resolution**	50 Hz
Duration	00 h 32 m 33 s	**Processor Version**	0403

A140503_05

AS30A05_ASWL1B0403201405O3T161143_20140503T170043_0001.DBL

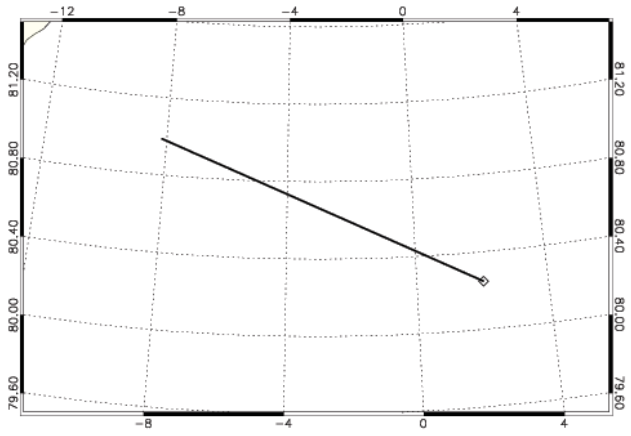


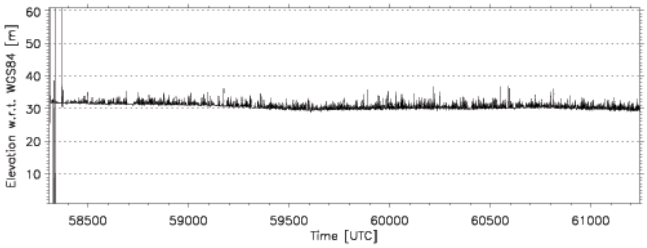


Date	2014-05-03	**Instrument Mode**	Adv. Low Altitude
Start Time	16:11:43 (58303)	**Aircraft**	DNSC Twin Otter
Stop Time	17:00:42 (61242)	**Retracker**	OCOG
Distance	201.697 km	**INS Resolution**	50 Hz
Duration	00 h 48 m 60 s	**Processor Version**	0403

A140503_05

AS30A05_ASWL1B0403201405O3T161143_20140503T170043_0001.DBL

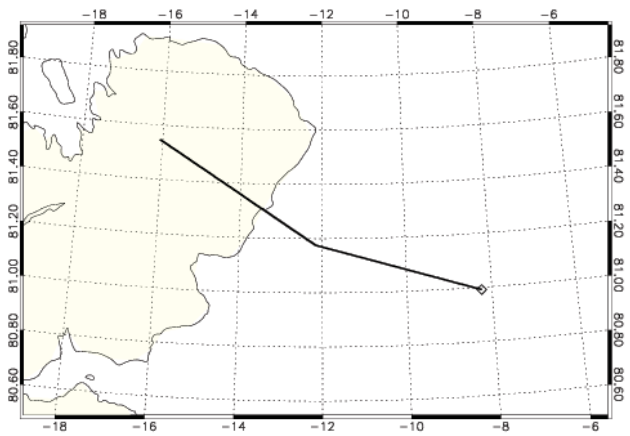


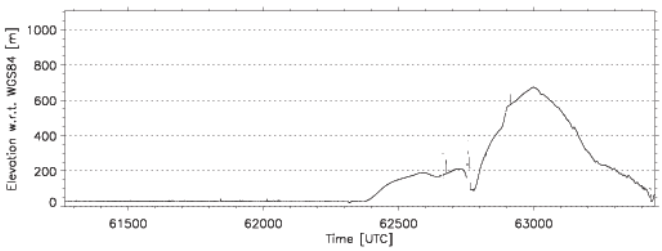


Date	2014-05-03	**Instrument Mode**	Adv. Low Altitude
Start Time	16:11:44 (58304)	**Aircraft**	DNSC Twin Otter
Stop Time	17:00:43 (61243)	**Retracker**	TSRA
Distance	201.683 km	**INS Resolution**	50 Hz
Duration	00 h 48 m 60 s	**Processor Version**	0403

A140503_06

AS30A06_ASWL1B0403201405O3T170104_20140503T173728_0001.DBL

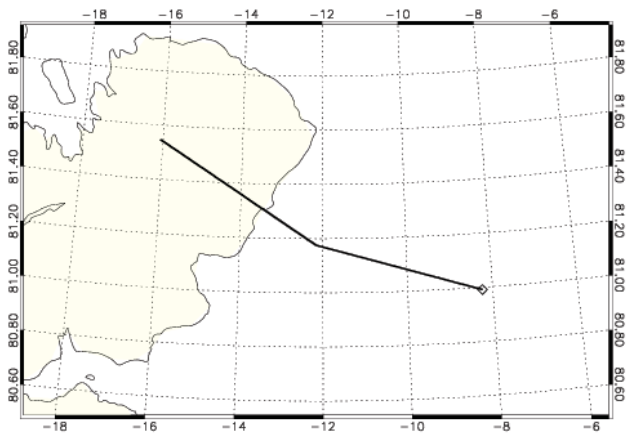


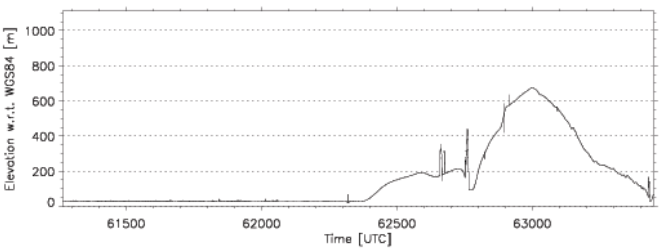


Date	2014-05-03	**Instrument Mode**	Adv. Low Altitude
Start Time	17:01:04 (61264)	**Aircraft**	DNSC Twin Otter
Stop Time	17:37:27 (63447)	**Retracker**	OCOG
Distance	147.733 km	**INS Resolution**	50 Hz
Duration	00 h 36 m 23 s	**Processor Version**	0403

A140503_06

AS30A06_ASWL1B0403201405O3T170104_20140503T173728_0001.DBL

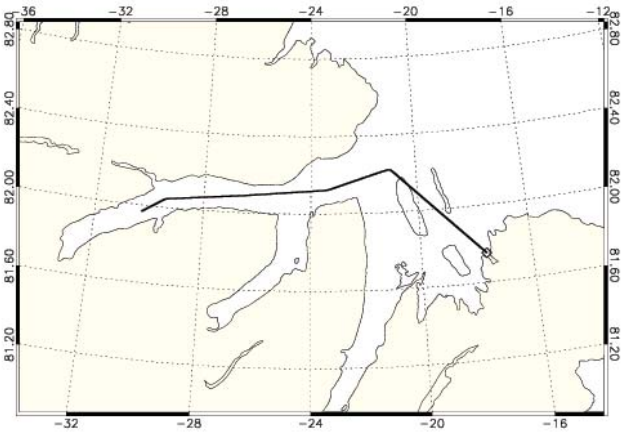


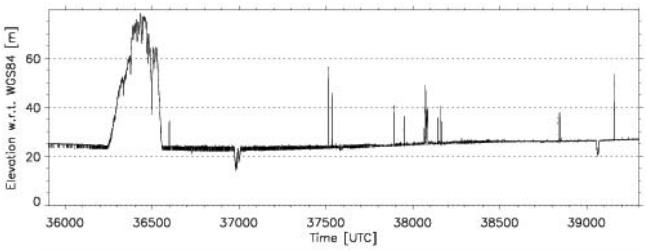


Date	2014-05-03	**Instrument Mode**	Adv. Low Altitude
Start Time	17:01:05 (61265)	**Aircraft**	DNSC Twin Otter
Stop Time	17:37:28 (63448)	**Retracker**	TSRA
Distance	147.740 km	**INS Resolution**	50 Hz
Duration	00 h 36 m 23 s	**Processor Version**	0403

A140505_00

AS30A00_ASWL180403201405050T095825_20140505T105501_0001.DBL

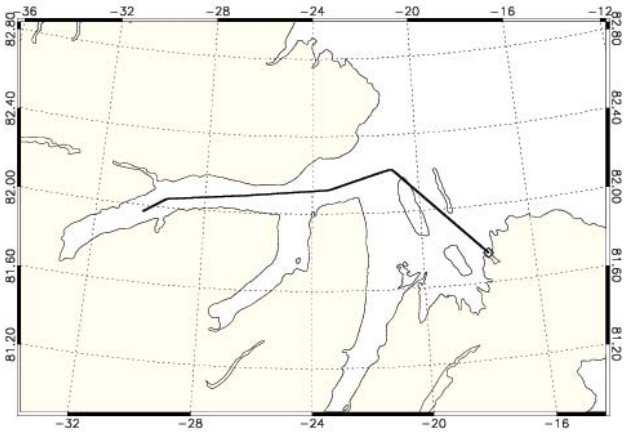


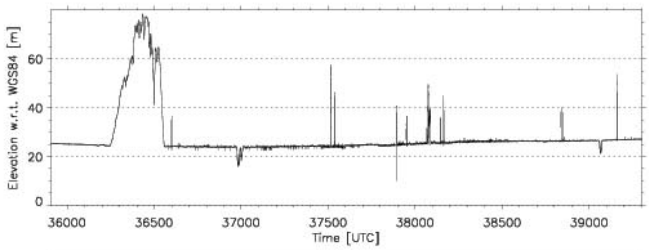


Date	2014-05-05	**Instrument Mode**	Adv. Low Altitude
Start Time	09:58:25 (35905)	**Aircraft**	DNSC Twin Otter
Stop Time	10:55:00 (39300)	**Retracker**	OCOG
Distance	219.805 km	**INS Resolution**	50 Hz
Duration	00 h 56 m 36 s	**Processor Version**	0403

A140505_00

AS30A00_ASWL180403201405050T095825_20140505T105501_0001.DBL

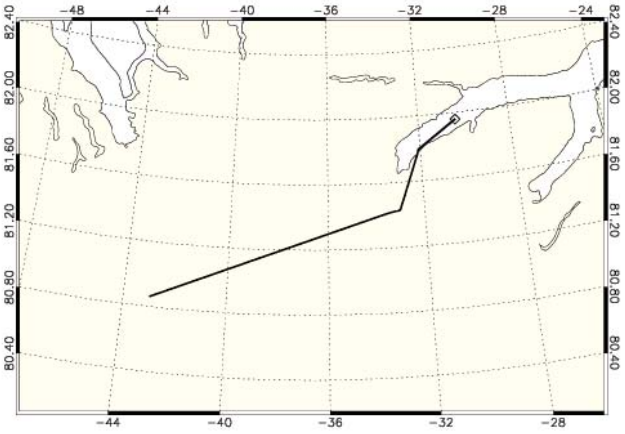


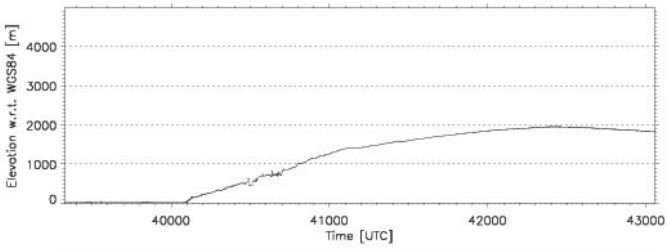


Date	2014-05-05	**Instrument Mode**	Adv. Low Altitude
Start Time	09:58:26 (35906)	**Aircraft**	DNSC Twin Otter
Stop Time	10:55:01 (39301)	**Retracker**	TSRA
Distance	219.813 km	**INS Resolution**	50 Hz
Duration	00 h 56 m 36 s	**Processor Version**	0403

A140505_01

AS30A01_ASWL180403201405051105526_20140505T115737_0001.DBL

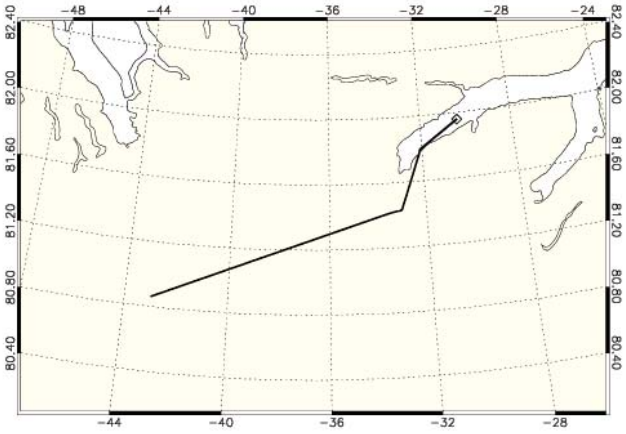


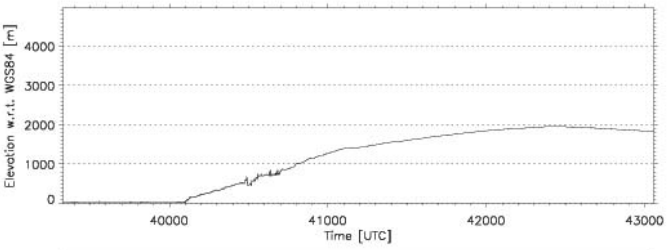


Date	2014-05-05	**Instrument Mode**	Adv. Low Altitude
Start Time	10:55:26 (39326)	**Aircraft**	DNSC Twin Otter
Stop Time	11:57:36 (43056)	**Retracker**	OCOG
Distance	257.310 km	**INS Resolution**	50 Hz
Duration	01 h 02 m 11 s	**Processor Version**	0403

A140505_01

AS30A01_ASWL180403201405051105526_20140505T115737_0001.DBL

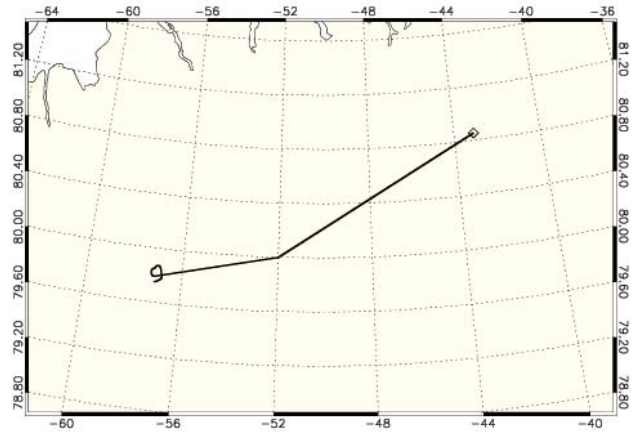


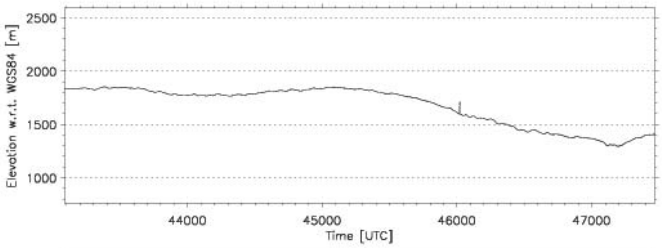


Date	2014-05-05	**Instrument Mode**	Adv. Low Altitude
Start Time	10:55:27 (39327)	**Aircraft**	DNSC Twin Otter
Stop Time	11:57:37 (43057)	**Retracker**	TSRA
Distance	257.362 km	**INS Resolution**	50 Hz
Duration	01 h 02 m 11 s	**Processor Version**	0403

A140505_02

AS30A02_ASWL1804032014050 5T115807_20140505T131110_0001.DBL

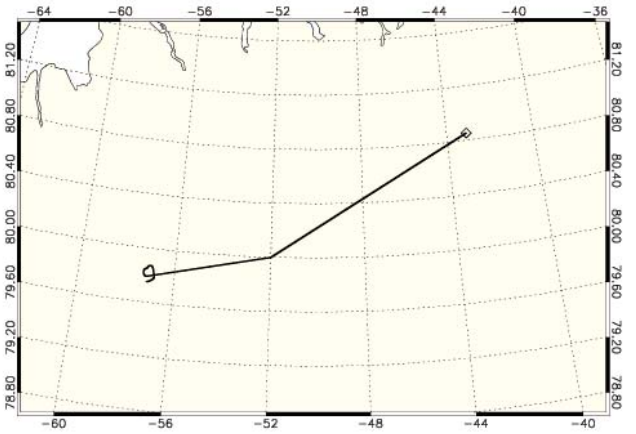


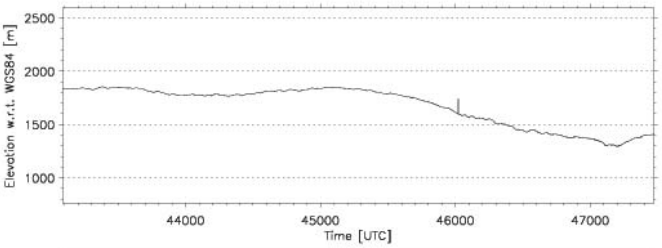


Date	2014−05−05	**Instrument Mode**	Adv. Low Altitude
Start Time	11:58:07 (43087)	**Aircraft**	DNSC Twin Otter
Stop Time	13:11:09 (47469)	**Retracker**	OCOG
Distance	323.892 km	**INS Resolution**	50 Hz
Duration	01 h 13 m 03 s	**Processor Version**	0403

A140505_02

AS30A02_ASWL1804032014050 5T115807_20140505T131110_0001.DBL

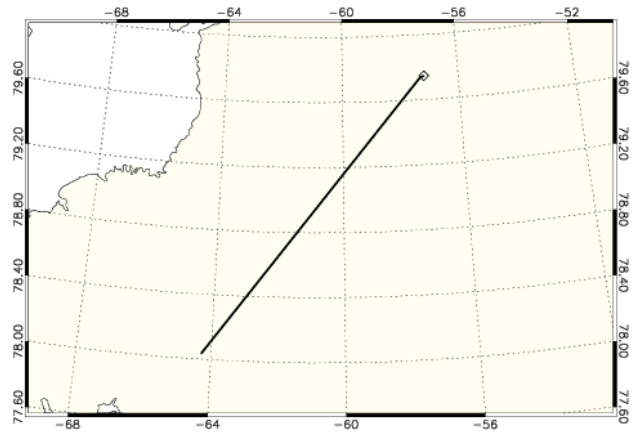


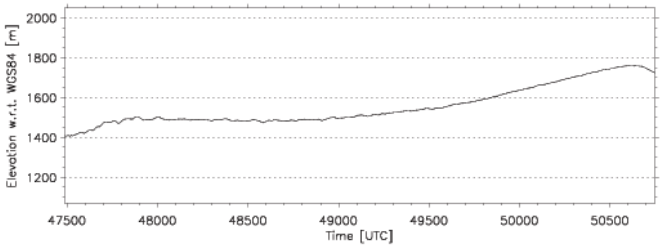


Date	2014−05−05	**Instrument Mode**	Adv. Low Altitude
Start Time	11:58:08 (43088)	**Aircraft**	DNSC Twin Otter
Stop Time	13:11:10 (47470)	**Retracker**	TSRA
Distance	323.779 km	**INS Resolution**	50 Hz
Duration	01 h 13 m 03 s	**Processor Version**	0403

A140505_03

AS30A03_ASWL1804032014050 5T131126_20140505T140548_0001.DBL

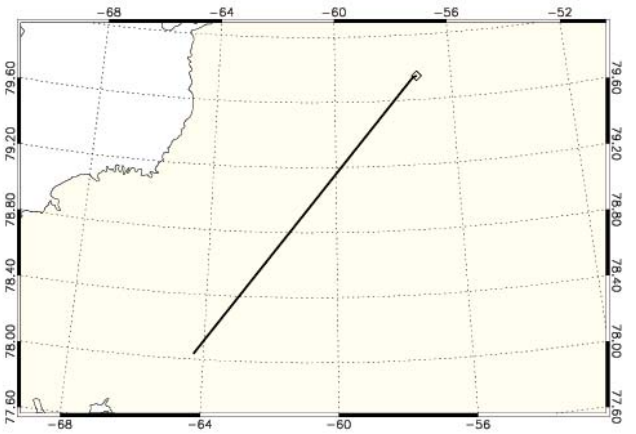


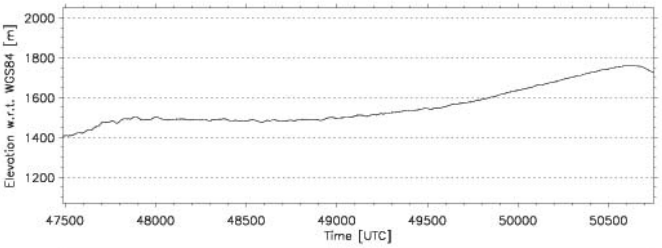


Date	2014−05−05	**Instrument Mode**	Adv. Low Altitude
Start Time	13:11:26 (47486)	**Aircraft**	DNSC Twin Otter
Stop Time	14:05:47 (50747)	**Retracker**	OCOG
Distance	243.821 km	**INS Resolution**	50 Hz
Duration	00 h 54 m 22 s	**Processor Version**	0403

A140505_03

AS30A03_ASWL1804032014050 5T131126_20140505T140548_0001.DBL

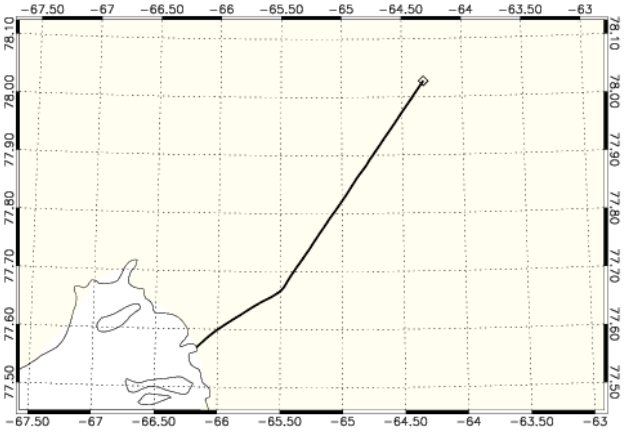


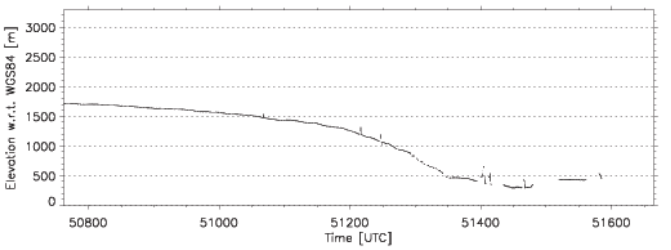


Date	2014−05−05	**Instrument Mode**	Adv. Low Altitude
Start Time	13:11:27 (47487)	**Aircraft**	DNSC Twin Otter
Stop Time	14:05:48 (50748)	**Retracker**	TSRA
Distance	243.956 km	**INS Resolution**	50 Hz
Duration	00 h 54 m 22 s	**Processor Version**	0403

A140505_04

AS3OA04_ASWL1B0403201405051140602_20140505T142105_0001.DBL

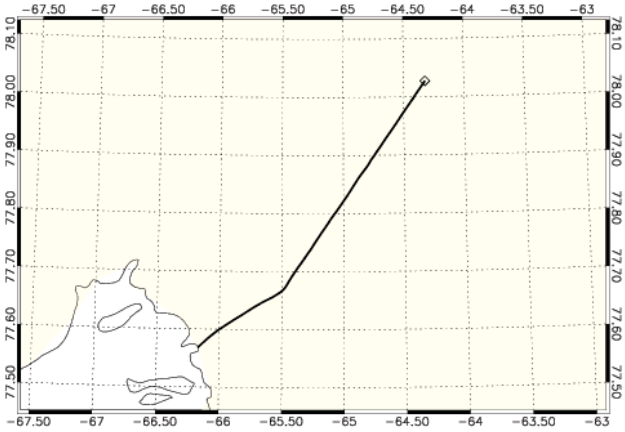


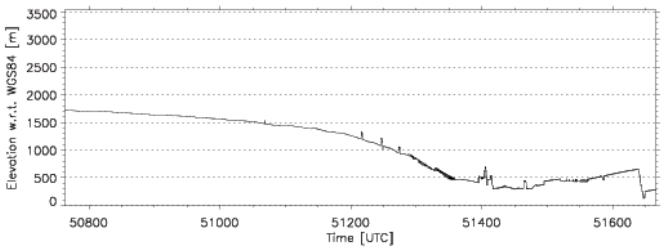


Date	2014−05−05	**Instrument Mode**	Adv. Low Altitude
Start Time	14:06:02 (50762)	**Aircraft**	DNSC Twin Otter
Stop Time	14:21:04 (51664)	**Retracker**	OCOG
Distance	68.142 km	**INS Resolution**	50 Hz
Duration	00 h 15 m 03 s	**Processor Version**	0403

A140505_04

AS3OA04_ASWL1B0403201405051140602_20140505T142105_0001.DBL

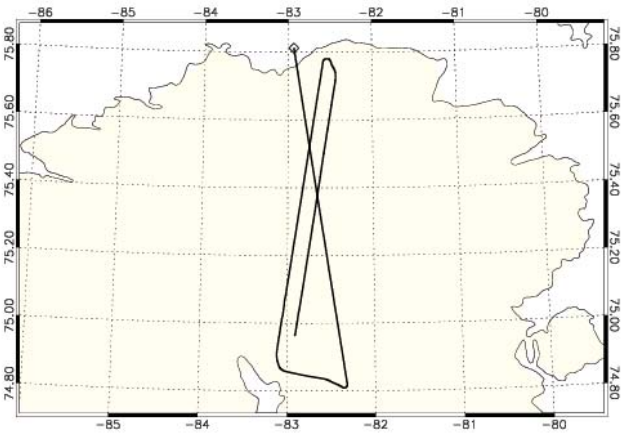


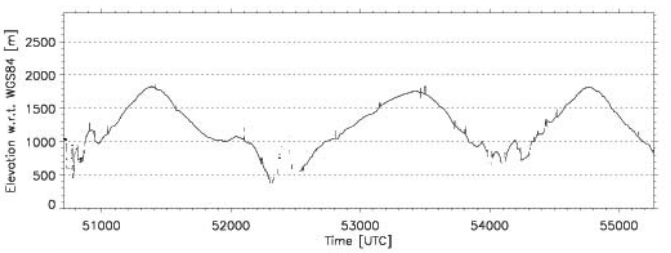


Date	2014−05−05	**Instrument Mode**	Adv. Low Altitude
Start Time	14:06:03 (50763)	**Aircraft**	DNSC Twin Otter
Stop Time	14:21:05 (51665)	**Retracker**	TSRA
Distance	68.151 km	**INS Resolution**	50 Hz
Duration	00 h 15 m 03 s	**Processor Version**	0403

A140506_00

AS3OA00_ASWL1B0403201405061140505_20140506T152109_0001.DBL

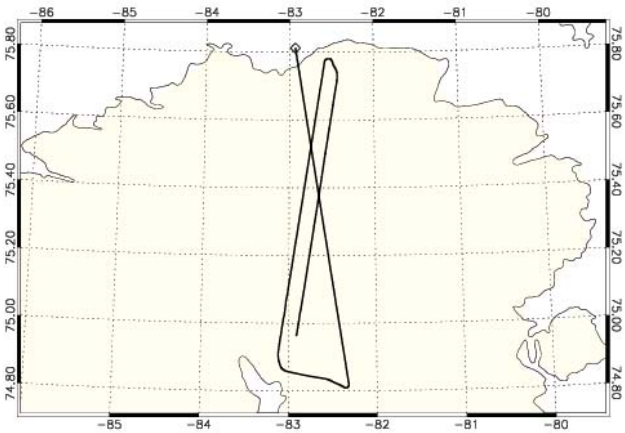


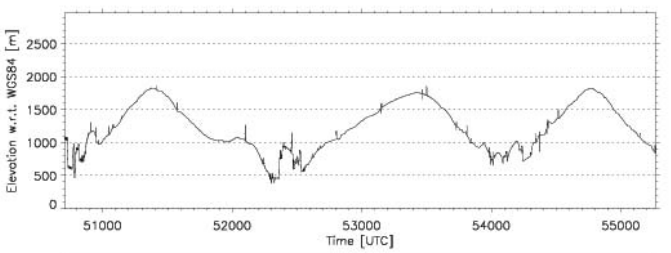


Date	2014−05−06	**Instrument Mode**	Adv. Low Altitude
Start Time	14:05:05 (50705)	**Aircraft**	DNSC Twin Otter
Stop Time	15:21:08 (55268)	**Retracker**	OCOG
Distance	333.421 km	**INS Resolution**	50 Hz
Duration	01 h 16 m 03 s	**Processor Version**	0403

A140506_00

AS3OA00_ASWL1B0403201405061140505_20140506T152109_0001.DBL

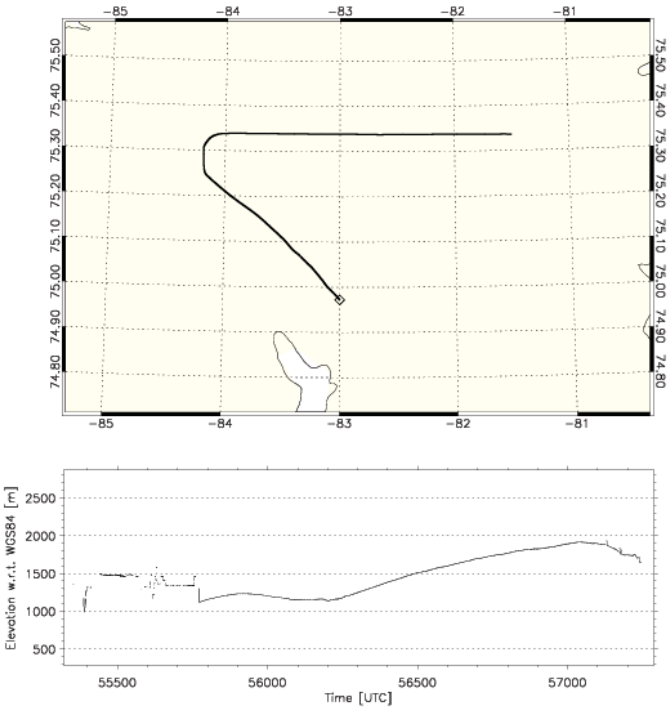




Date	2014−05−06	**Instrument Mode**	Adv. Low Altitude
Start Time	14:05:06 (50706)	**Aircraft**	DNSC Twin Otter
Stop Time	15:21:09 (55269)	**Retracker**	TSRA
Distance	333.509 km	**INS Resolution**	50 Hz
Duration	01 h 16 m 03 s	**Processor Version**	0403

A140506_01

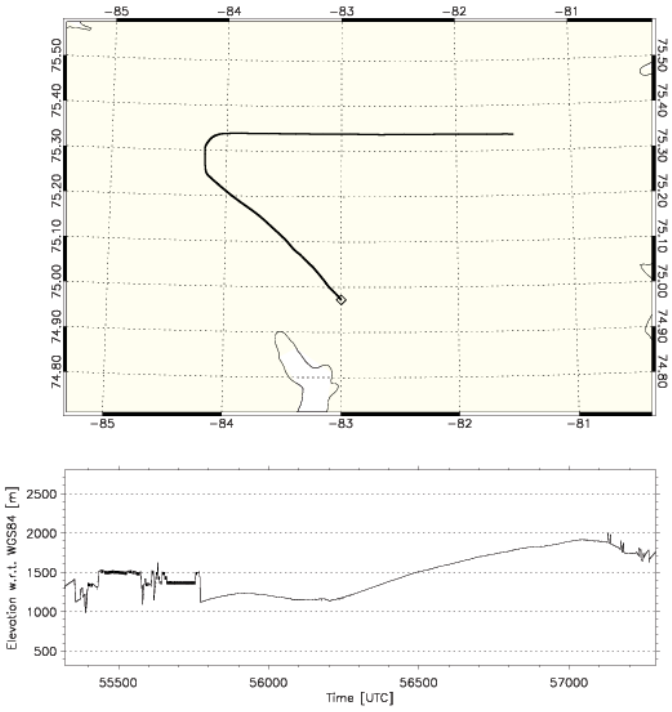
AS30A01_ASWL18040320140506T152200_20140506T155448_0001.DBL



Date	2014-05-06	**Instrument Mode**	Adv. Low Altitude
Start Time	15:22:00 (55320)	**Aircraft**	DNSC Twin Otter
Stop Time	15:54:47 (57287)	**Retracker**	OCOG
Distance	129.541 km	**INS Resolution**	50 Hz
Duration	00 h 32 m 48 s	**Processor Version**	0403

A140506_01

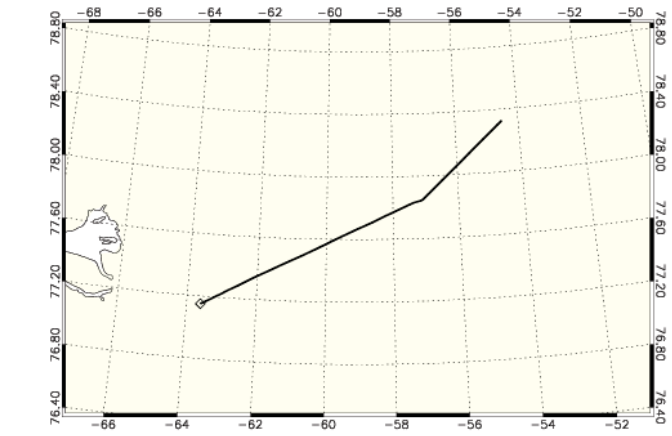
AS30A01_ASWL18040320140506T152200_20140506T155448_0001.DBL

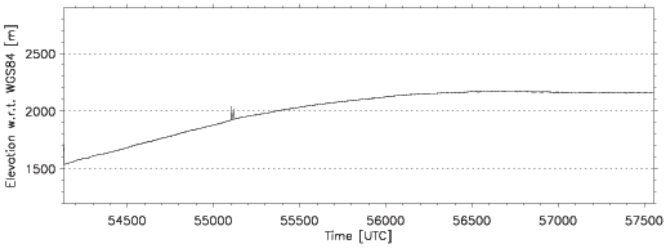


Date	2014-05-06	**Instrument Mode**	Adv. Low Altitude
Start Time	15:22:01 (55321)	**Aircraft**	DNSC Twin Otter
Stop Time	15:54:48 (57288)	**Retracker**	TSRA
Distance	129.548 km	**INS Resolution**	50 Hz
Duration	00 h 32 m 48 s	**Processor Version**	0403

A140507_00

AS30A00_ASWL18040320140507T150210_20140507T155916_0001.DBL

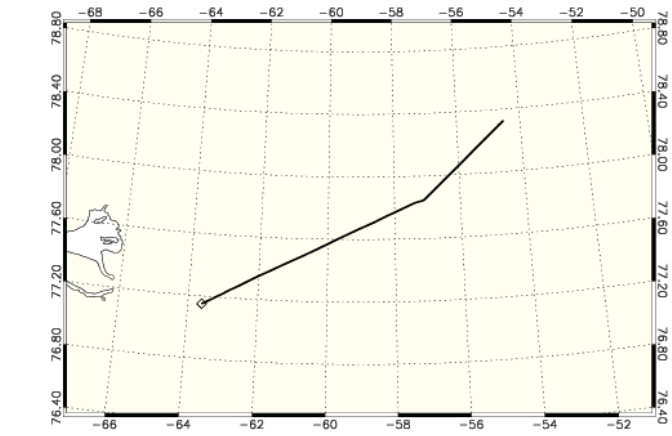


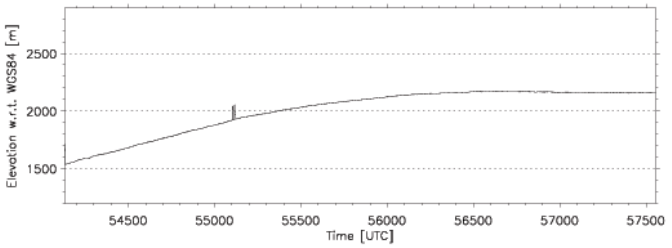


Date	2014-05-07	**Instrument Mode**	Adv. Low Altitude
Start Time	15:02:10 (54130)	**Aircraft**	DNSC Twin Otter
Stop Time	15:59:15 (57555)	**Retracker**	OCOG
Distance	253.772 km	**INS Resolution**	50 Hz
Duration	00 h 57 m 06 s	**Processor Version**	0403

A140507_00

AS30A00_ASWL18040320140507T150210_20140507T155916_0001.DBL

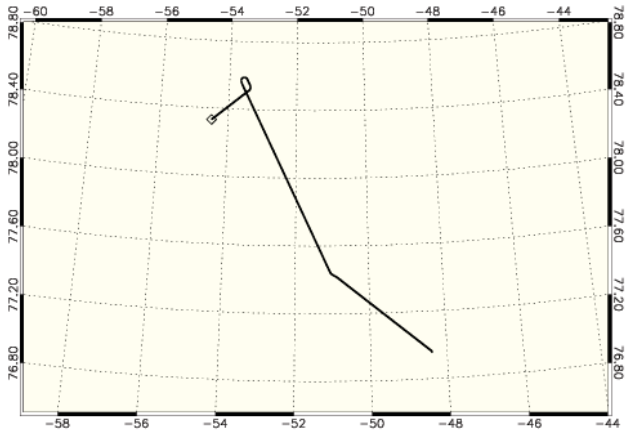


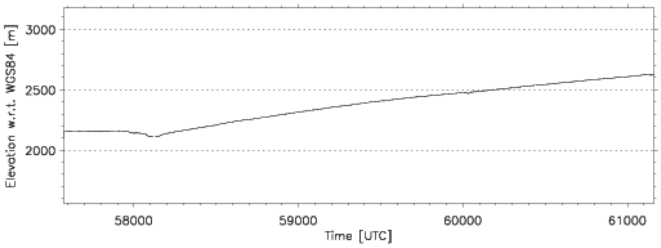


Date	2014-05-07	**Instrument Mode**	Adv. Low Altitude
Start Time	15:02:11 (54131)	**Aircraft**	DNSC Twin Otter
Stop Time	15:59:16 (57556)	**Retracker**	TSRA
Distance	253.817 km	**INS Resolution**	50 Hz
Duration	00 h 57 m 06 s	**Processor Version**	0403

A140507_01

AS30A01_ASWL18040320140507T155932_20140507T165921_0001.DBL

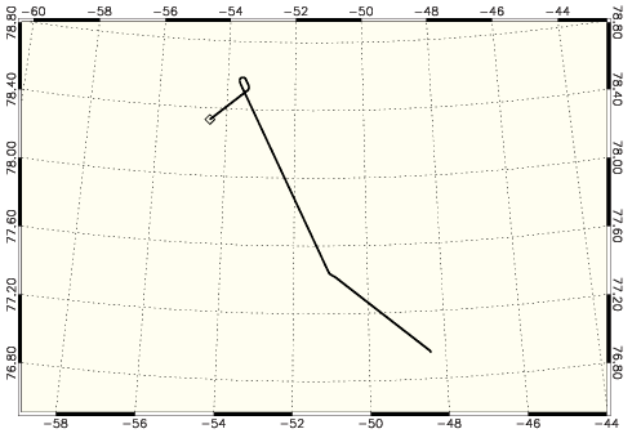


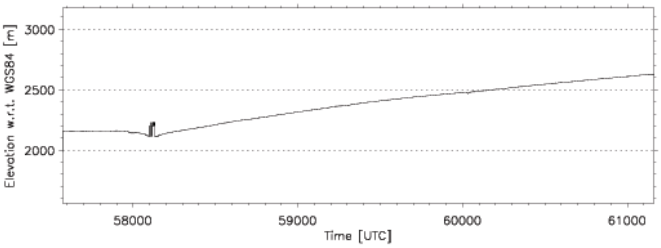


Date	2014-05-07	**Instrument Mode**	Adv. Low Altitude
Start Time	15:59:32 (57572)	**Aircraft**	DNSC Twin Otter
Stop Time	16:59:20 (61160)	**Retracker**	OCOG
Distance	269.038 km	**INS Resolution**	50 Hz
Duration	00 h 59 m 49 s	**Processor Version**	0403

A140507_01

AS30A01_ASWL18040320140507T155932_20140507T165921_0001.DBL

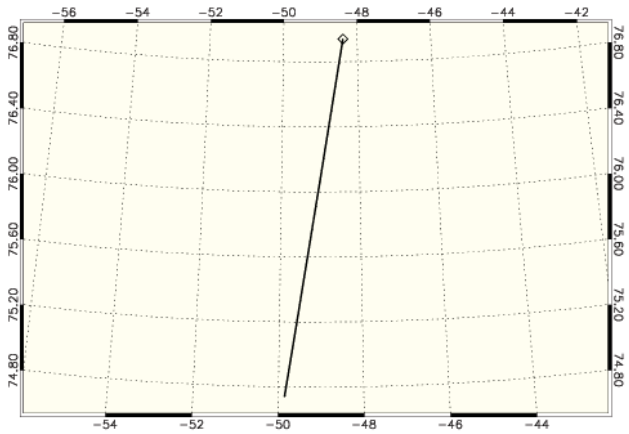


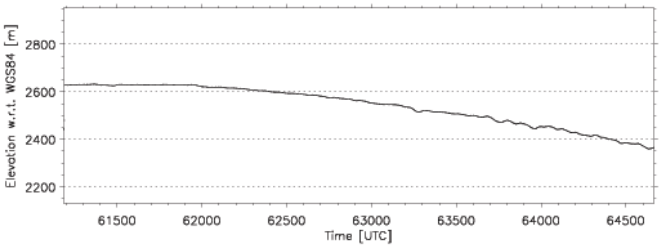


Date	2014-05-07	**Instrument Mode**	Adv. Low Altitude
Start Time	15:59:33 (57573)	**Aircraft**	DNSC Twin Otter
Stop Time	16:59:21 (61161)	**Retracker**	TSRA
Distance	269.067 km	**INS Resolution**	50 Hz
Duration	00 h 59 m 49 s	**Processor Version**	0403

A140507_02

AS30A02_ASWL18040320140507T165944_20140507T175746_0001.DBL

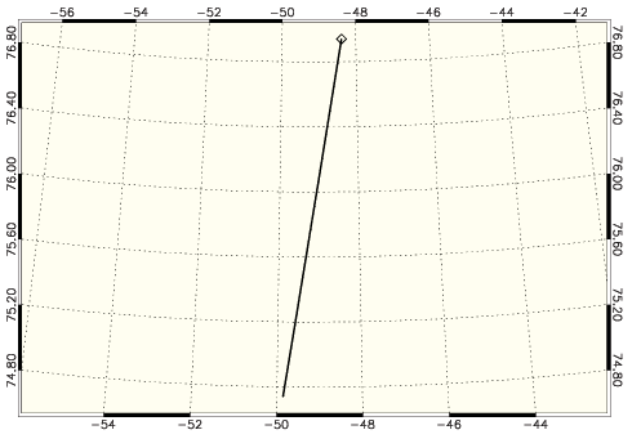


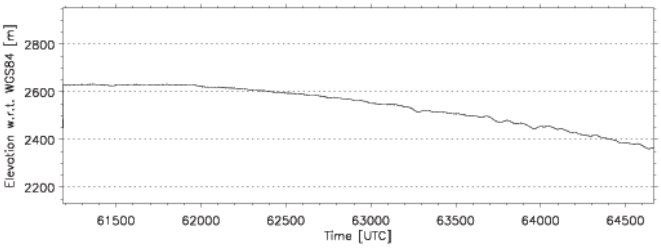


Date	2014-05-07	**Instrument Mode**	Adv. Low Altitude
Start Time	16:59:44 (61184)	**Aircraft**	DNSC Twin Otter
Stop Time	17:57:45 (64665)	**Retracker**	OCOG
Distance	247.839 km	**INS Resolution**	50 Hz
Duration	00 h 58 m 02 s	**Processor Version**	0403

A140507_02

AS30A02_ASWL18040320140507T165944_20140507T175746_0001.DBL

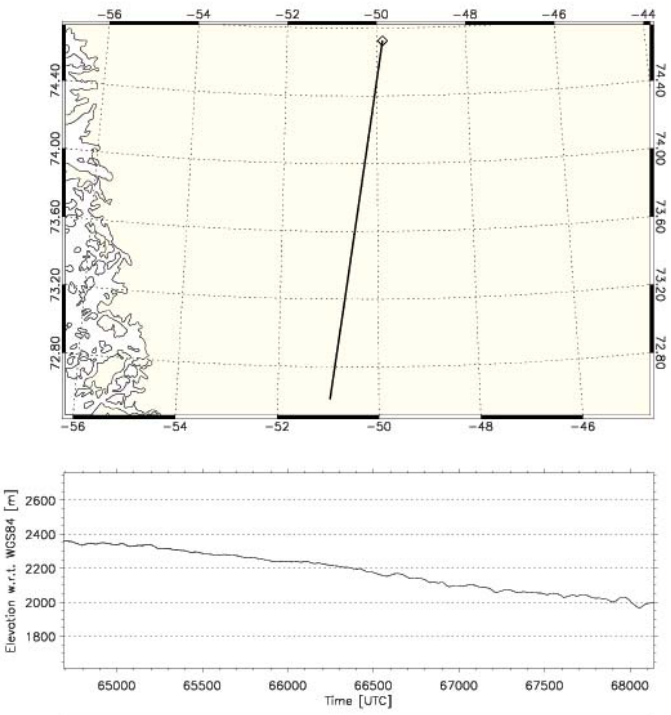




Date	2014-05-07	**Instrument Mode**	Adv. Low Altitude
Start Time	16:59:45 (61185)	**Aircraft**	DNSC Twin Otter
Stop Time	17:57:46 (64666)	**Retracker**	TSRA
Distance	248.005 km	**INS Resolution**	50 Hz
Duration	00 h 58 m 02 s	**Processor Version**	0403

A140507_03

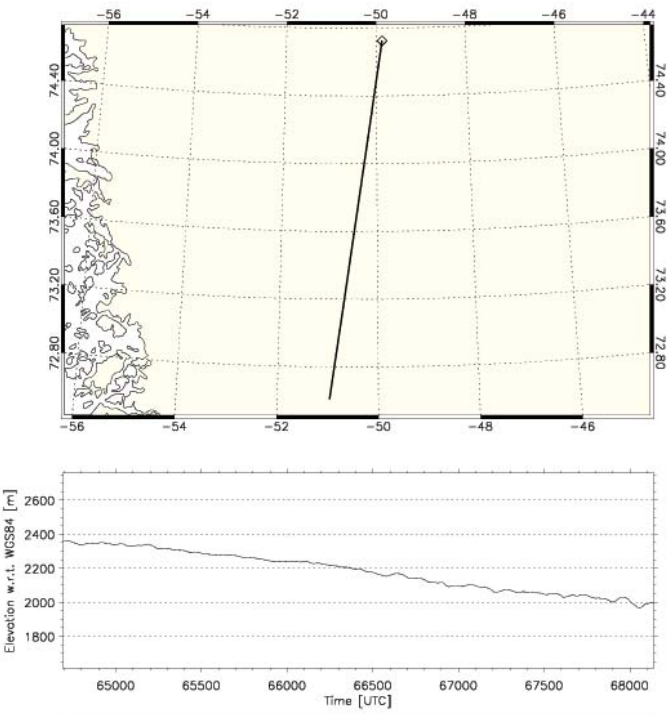
AS30A03_ASWL180403201405071175809_20140507T185540_0001.DBL



Date	2014−05−07	**Instrument Mode**	Adv. Low Altitude
Start Time	17:58:09 (64689)	**Aircraft**	DNSC Twin Otter
Stop Time	18:55:39 (68139)	**Retracker**	OCOG
Distance	237.388 km	**INS Resolution**	50 Hz
Duration	00 h 57 m 31 s	**Processor Version**	0403

A140507_03

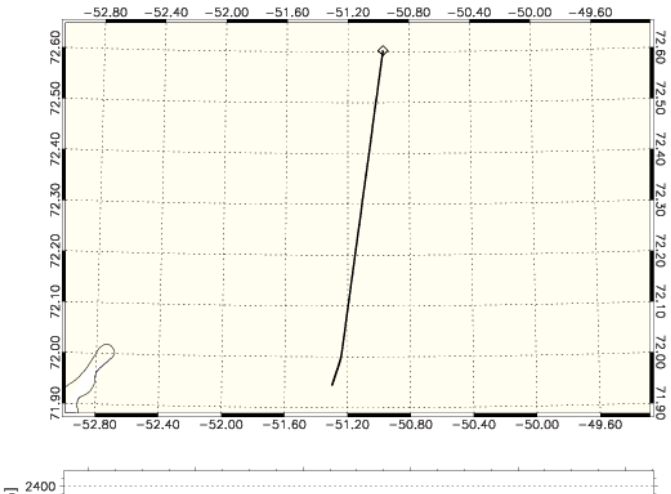
AS30A03_ASWL180403201405071175809_20140507T185540_0001.DBL

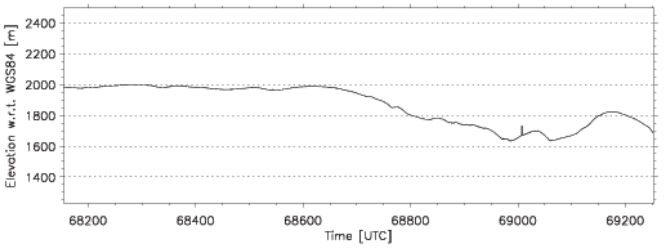


Date	2014−05−07	**Instrument Mode**	Adv. Low Altitude
Start Time	17:58:10 (64690)	**Aircraft**	DNSC Twin Otter
Stop Time	18:55:40 (68140)	**Retracker**	TSRA
Distance	237.159 km	**INS Resolution**	50 Hz
Duration	00 h 57 m 31 s	**Processor Version**	0403

A140507_04

AS30A04_ASWL180403201405071185554_20140507T191414_0001.DBL

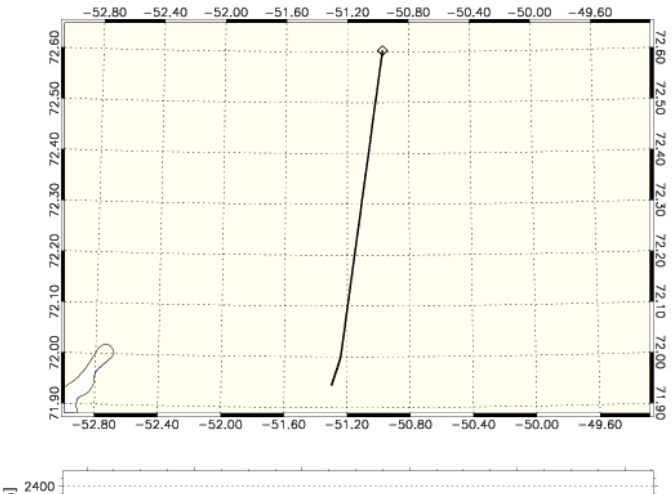


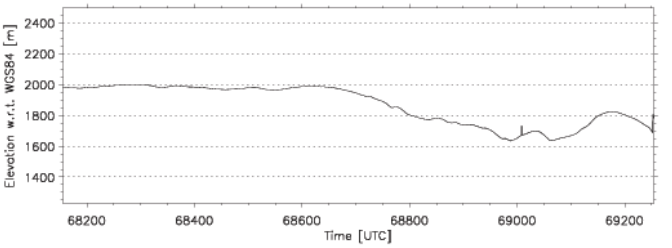


Date	2014−05−07	**Instrument Mode**	Adv. Low Altitude
Start Time	18:55:54 (68154)	**Aircraft**	DNSC Twin Otter
Stop Time	19:14:13 (69253)	**Retracker**	OCOG
Distance	74.324 km	**INS Resolution**	50 Hz
Duration	00 h 18 m 19 s	**Processor Version**	0403

A140507_04

AS30A04_ASWL180403201405071185554_20140507T191414_0001.DBL

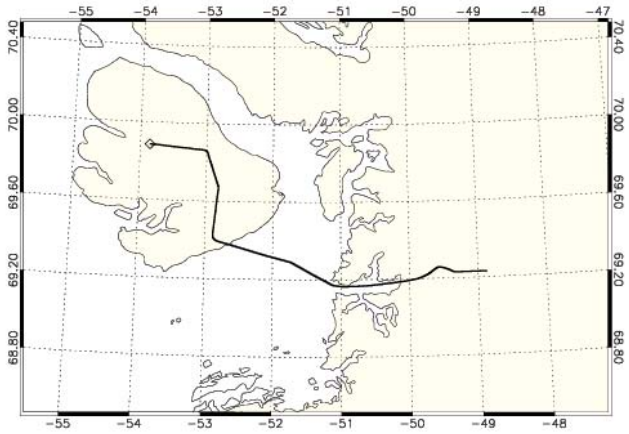


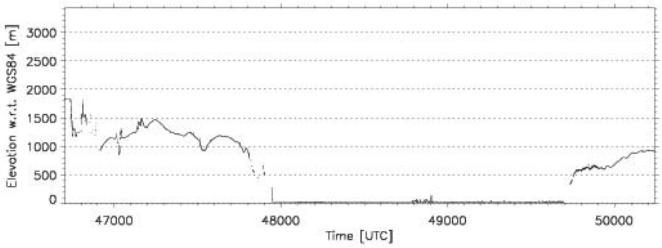


Date	2014−05−07	**Instrument Mode**	Adv. Low Altitude
Start Time	18:55:55 (68155)	**Aircraft**	DNSC Twin Otter
Stop Time	19:14:14 (69254)	**Retracker**	TSRA
Distance	74.333 km	**INS Resolution**	50 Hz
Duration	00 h 18 m 19 s	**Processor Version**	0403

A140508_00

AS30A00_ASWL1804032014050BT125822_20140508T135724_0001.DBL

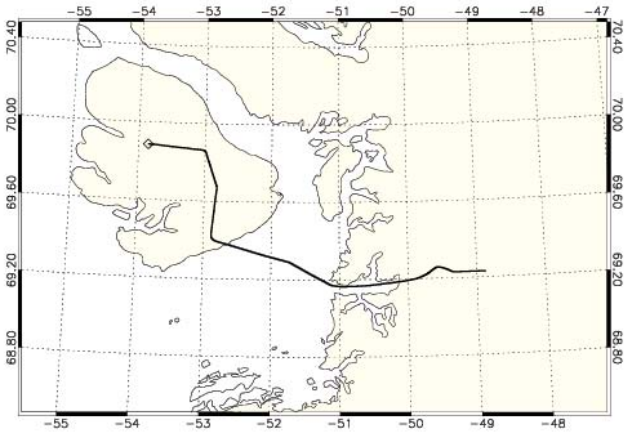


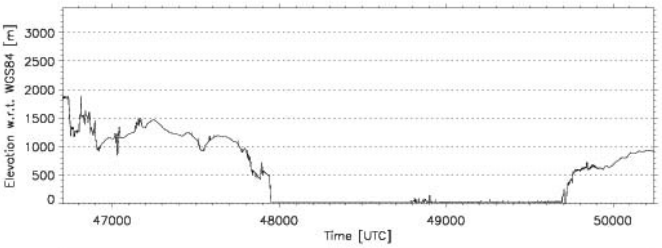


Date	2014-05-08	**Instrument Mode**	Adv. Low Altitude
Start Time	12:58:22 (46702)	**Aircraft**	DNSC Twin Otter
Stop Time	13:57:23 (50243)	**Retracker**	OCOG
Distance	250.528 km	**INS Resolution**	50 Hz
Duration	00 h 59 m 02 s	**Processor Version**	0403

A140508_00

AS30A00_ASWL1804032014050BT125822_20140508T135724_0001.DBL

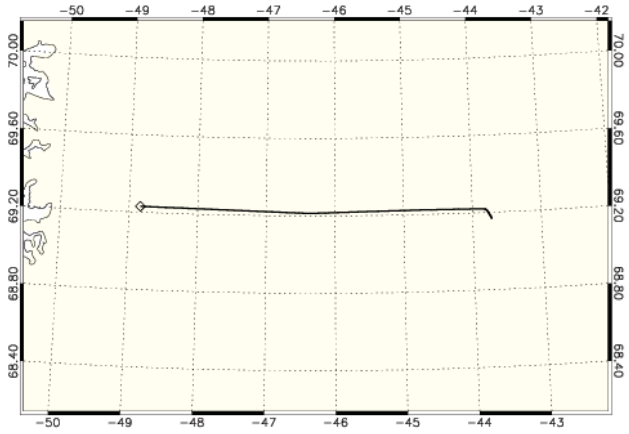


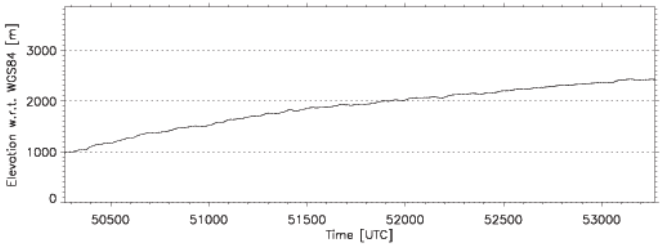


Date	2014-05-08	**Instrument Mode**	Adv. Low Altitude
Start Time	12:58:23 (46703)	**Aircraft**	DNSC Twin Otter
Stop Time	13:57:24 (50244)	**Retracker**	TSRA
Distance	250.554 km	**INS Resolution**	50 Hz
Duration	00 h 59 m 02 s	**Processor Version**	0403

A140508_01

AS30A01_ASWL1804032014050BT135745_20140508T144751_0001.DBL

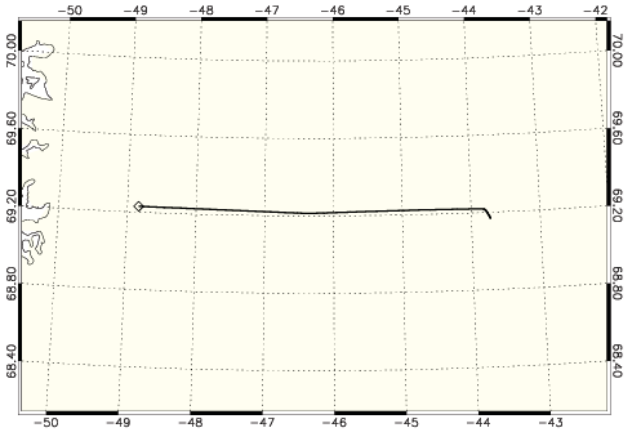


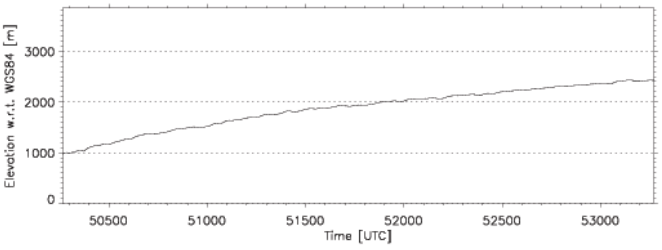


Date	2014-05-08	**Instrument Mode**	Adv. Low Altitude
Start Time	13:57:45 (50265)	**Aircraft**	DNSC Twin Otter
Stop Time	14:47:50 (53270)	**Retracker**	OCOG
Distance	205.237 km	**INS Resolution**	50 Hz
Duration	00 h 50 m 06 s	**Processor Version**	0403

A140508_01

AS30A01_ASWL1804032014050BT135745_20140508T144751_0001.DBL

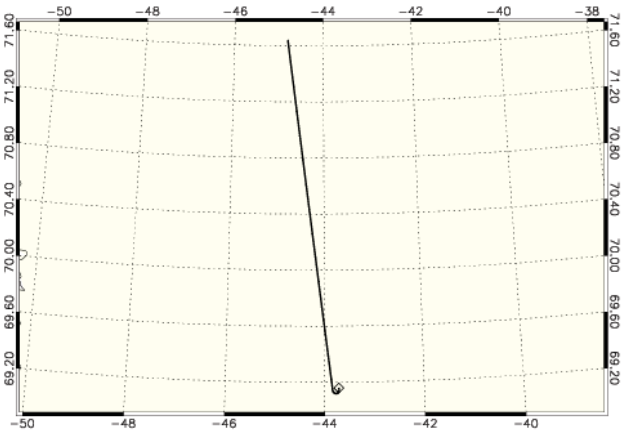


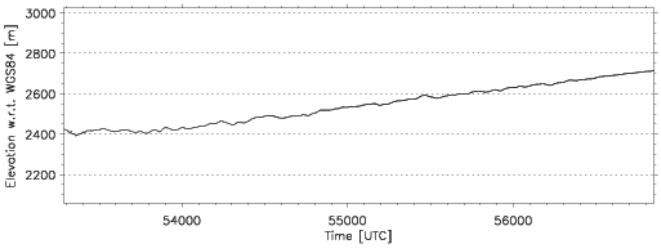


Date	2014-05-08	**Instrument Mode**	Adv. Low Altitude
Start Time	13:57:46 (50266)	**Aircraft**	DNSC Twin Otter
Stop Time	14:47:51 (53271)	**Retracker**	TSRA
Distance	205.237 km	**INS Resolution**	50 Hz
Duration	00 h 50 m 06 s	**Processor Version**	0403

A140508_02

AS30A02_ASWL1804032014050BT144805_20140508T154728_0001.DBL

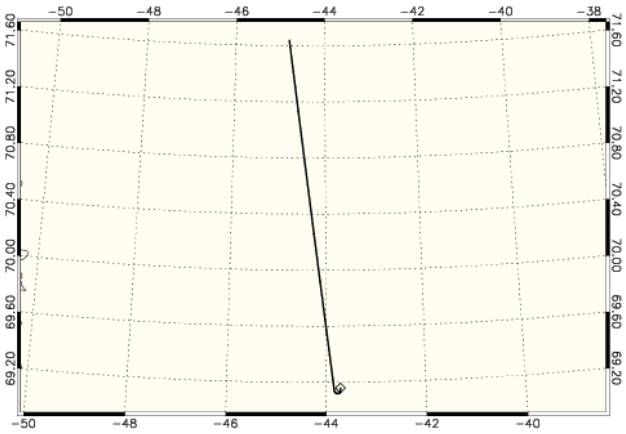


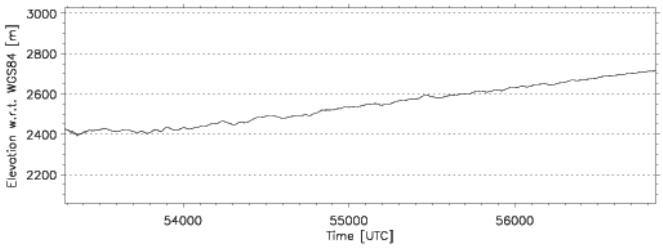


Date	2014-05-08	**Instrument Mode**	Adv. Low Altitude
Start Time	14:48:05 (53285)	**Aircraft**	DNSC Twin Otter
Stop Time	15:47:28 (56848)	**Retracker**	OCOG
Distance	289.626 km	**INS Resolution**	50 Hz
Duration	00 h 59 m 23 s	**Processor Version**	0403

A140508_02

AS30A02_ASWL1804032014050BT144805_20140508T154728_0001.DBL

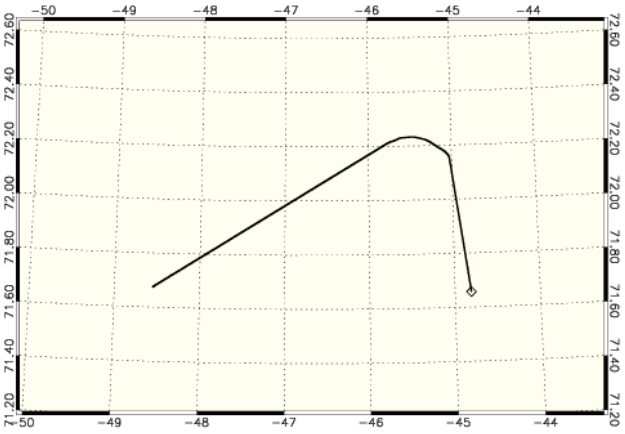


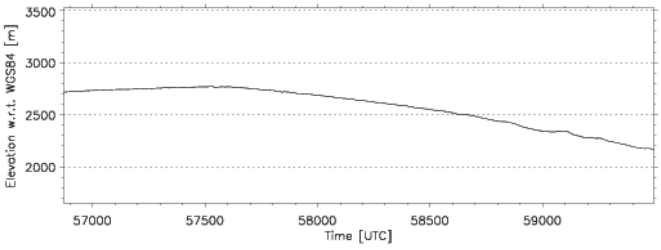


Date	2014-05-08	**Instrument Mode**	Adv. Low Altitude
Start Time	14:48:06 (53286)	**Aircraft**	DNSC Twin Otter
Stop Time	15:47:29 (56849)	**Retracker**	TSRA
Distance	289.324 km	**INS Resolution**	50 Hz
Duration	00 h 59 m 23 s	**Processor Version**	0403

A140508_03

AS30A03_ASWL1804032014050BT154751_20140508T163135_0001.DBL

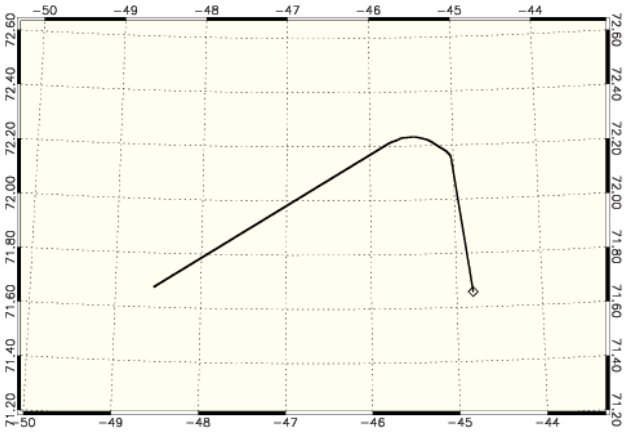


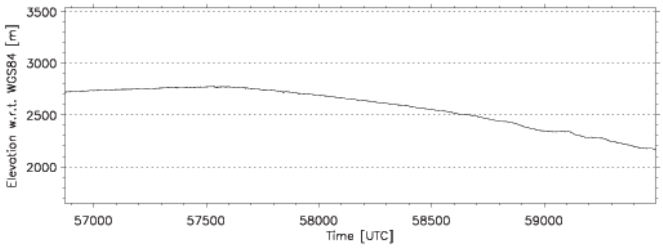


Date	2014-05-08	**Instrument Mode**	Adv. Low Altitude
Start Time	15:47:51 (56871)	**Aircraft**	DNSC Twin Otter
Stop Time	16:31:35 (59495)	**Retracker**	OCOG
Distance	197.533 km	**INS Resolution**	50 Hz
Duration	00 h 43 m 44 s	**Processor Version**	0403

A140508_03

AS30A03_ASWL1804032014050BT154751_20140508T163135_0001.DBL

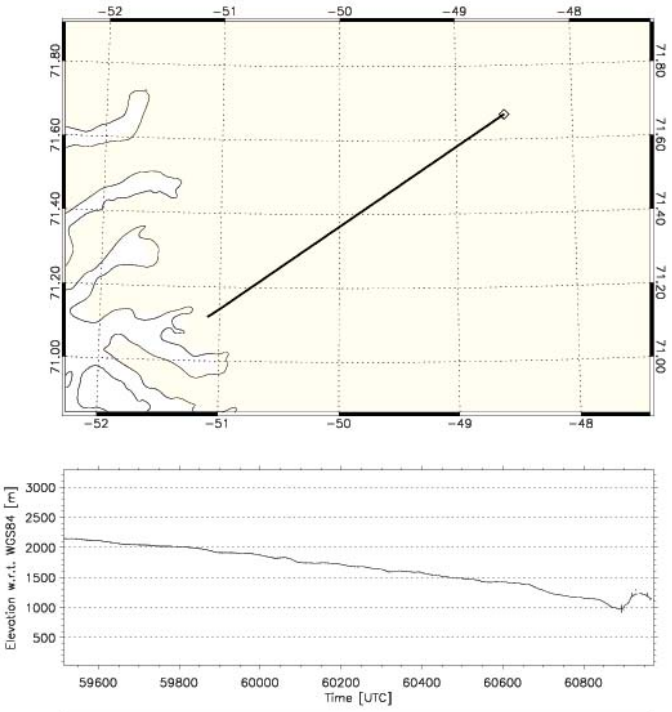




Date	2014-05-08	**Instrument Mode**	Adv. Low Altitude
Start Time	15:47:52 (56872)	**Aircraft**	DNSC Twin Otter
Stop Time	16:31:36 (59496)	**Retracker**	TSRA
Distance	197.548 km	**INS Resolution**	50 Hz
Duration	00 h 43 m 44 s	**Processor Version**	0403

A140508_04

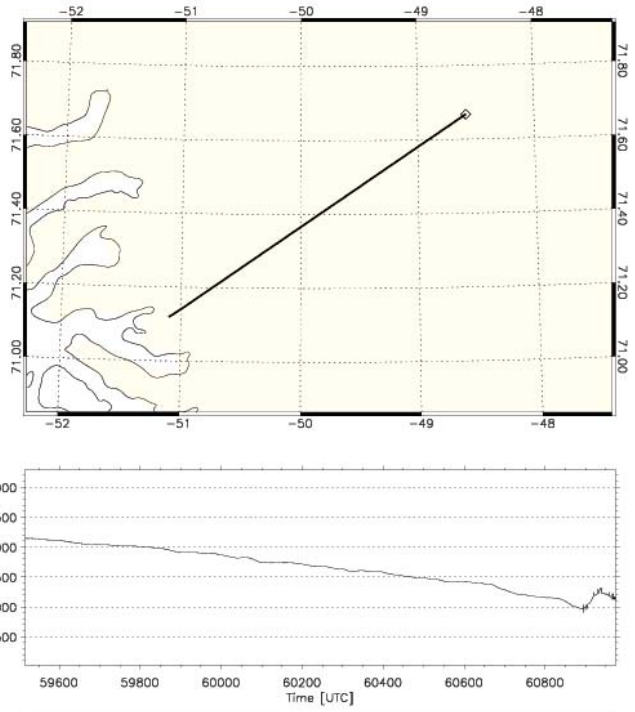
AS3OA04_ASIWL1804032014050811631 54_20140508T165614_0001.DBL



Date	2014−05−08	**Instrument Mode**	Adv. Low Altitude
Start Time	16:31:54 (59514)	**Aircraft**	DNSC Twin Otter
Stop Time	16:56:13 (60973)	**Retracker**	OCOG
Distance	107.979 km	**INS Resolution**	50 Hz
Duration	00 h 24 m 20 s	**Processor Version**	0403

A140508_04

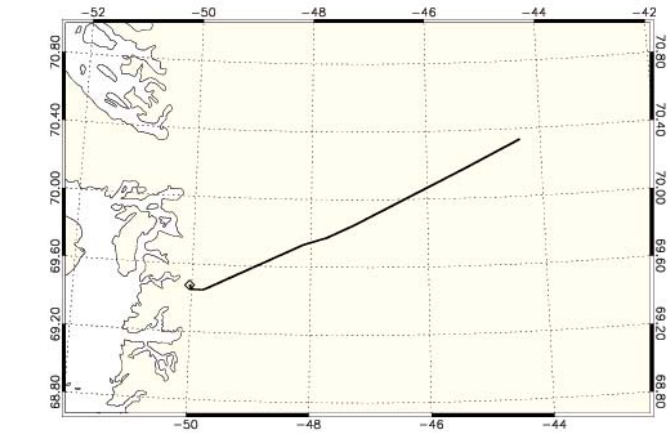
AS3OA04_ASIWL1804032014050811631 54_20140508T165614_0001.DBL

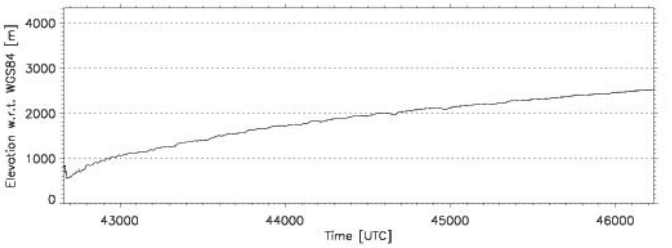


Date	2014−05−08	**Instrument Mode**	Adv. Low Altitude
Start Time	16:31:55 (59515)	**Aircraft**	DNSC Twin Otter
Stop Time	16:56:14 (60974)	**Retracker**	TSRA
Distance	107.978 km	**INS Resolution**	50 Hz
Duration	00 h 24 m 20 s	**Processor Version**	0403

A140509_00

AS3OA00_ASIWL1804032014050911505 9_20140509T125034_0001.DBL

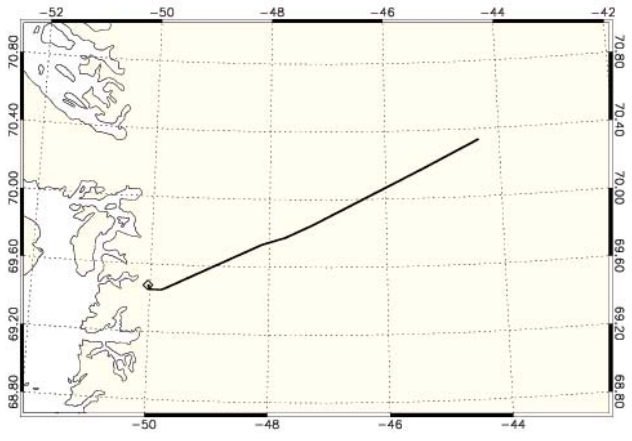


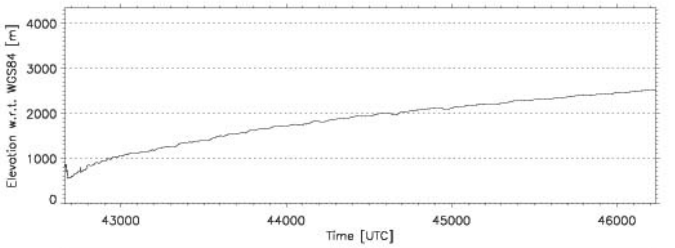


Date	2014−05−09	**Instrument Mode**	Adv. Low Altitude
Start Time	11:50:59 (42659)	**Aircraft**	DNSC Twin Otter
Stop Time	12:50:33 (46233)	**Retracker**	OCOG
Distance	240.593 km	**INS Resolution**	50 Hz
Duration	00 h 59 m 34 s	**Processor Version**	0403

A140509_00

AS3OA00_ASIWL1804032014050911505 9_20140509T125034_0001.DBL

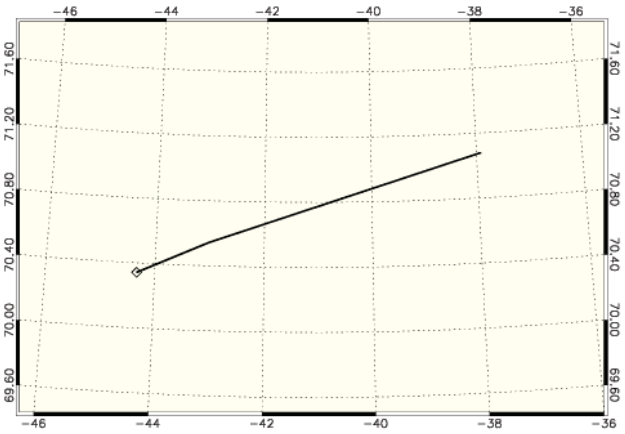


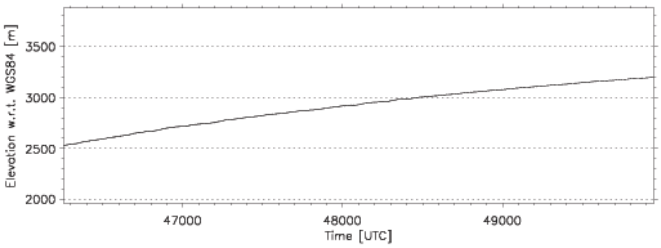


Date	2014−05−09	**Instrument Mode**	Adv. Low Altitude
Start Time	11:51:00 (42660)	**Aircraft**	DNSC Twin Otter
Stop Time	12:50:34 (46234)	**Retracker**	TSRA
Distance	240.592 km	**INS Resolution**	50 Hz
Duration	00 h 59 m 34 s	**Processor Version**	0403

A140509_01

AS30A01_ASWL1B0403201405091125055_20140509T135227_0001.DBL

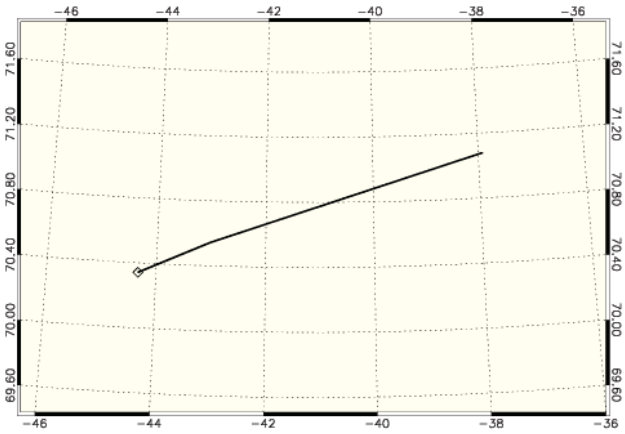


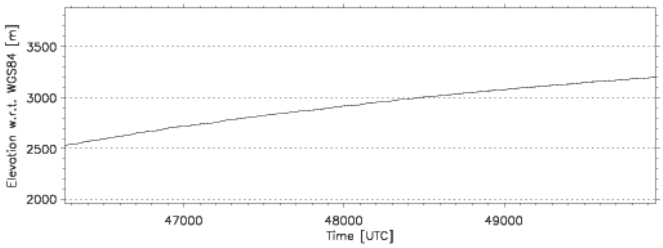


Date	2014-05-09	**Instrument Mode**	Adv. Low Altitude
Start Time	12:50:55 (46255)	**Aircraft**	DNSC Twin Otter
Stop Time	13:52:26 (49946)	**Retracker**	OCOG
Distance	248.842 km	**INS Resolution**	50 Hz
Duration	01 h 01 m 32 s	**Processor Version**	0403

A140509_01

AS30A01_ASWL1B0403201405091125055_20140509T135227_0001.DBL

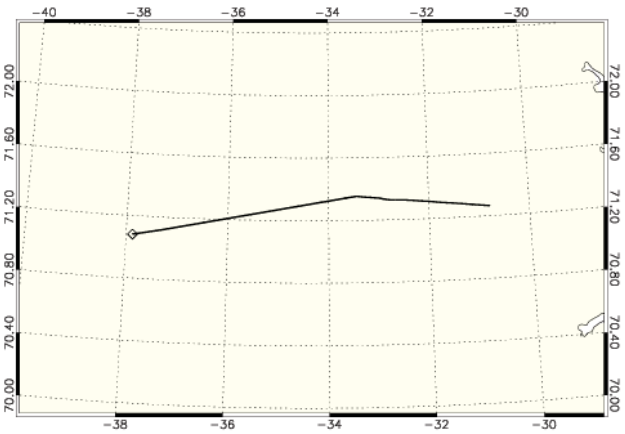


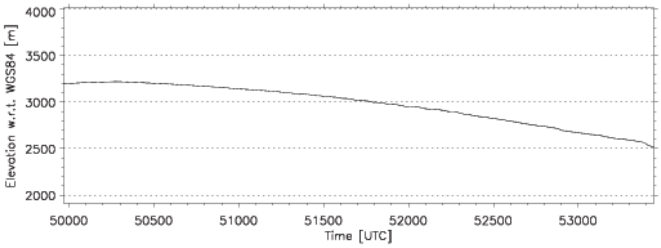


Date	2014-05-09	**Instrument Mode**	Adv. Low Altitude
Start Time	12:50:56 (46256)	**Aircraft**	DNSC Twin Otter
Stop Time	13:52:27 (49947)	**Retracker**	TSRA
Distance	248.807 km	**INS Resolution**	50 Hz
Duration	01 h 01 m 32 s	**Processor Version**	0403

A140509_02

AS30A02_ASWL1B0403201405091135248_20140509T145046_0001.DBL

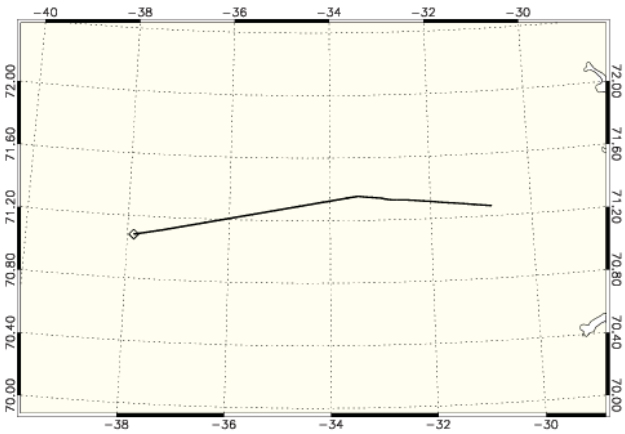


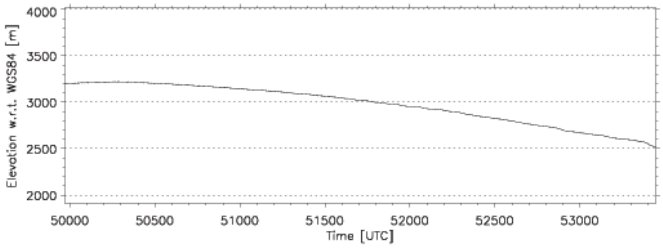


Date	2014-05-09	**Instrument Mode**	Adv. Low Altitude
Start Time	13:52:48 (49968)	**Aircraft**	DNSC Twin Otter
Stop Time	14:50:46 (53446)	**Retracker**	OCOG
Distance	256.313 km	**INS Resolution**	50 Hz
Duration	00 h 57 m 58 s	**Processor Version**	0403

A140509_02

AS30A02_ASWL1B0403201405091135248_20140509T145046_0001.DBL

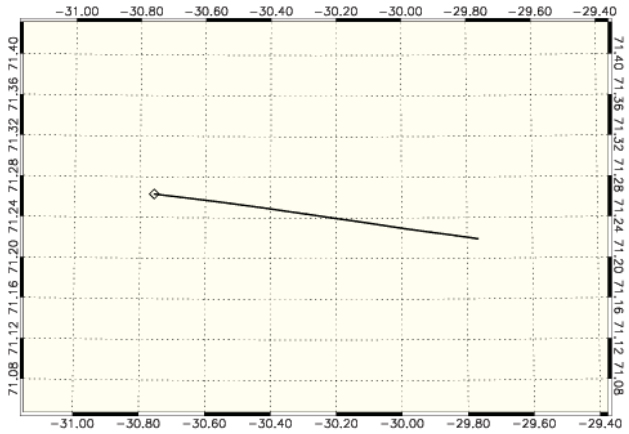


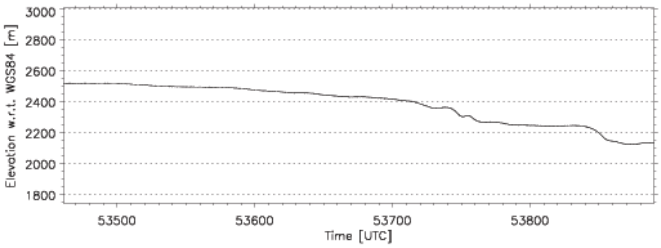


Date	2014-05-09	**Instrument Mode**	Adv. Low Altitude
Start Time	13:52:49 (49969)	**Aircraft**	DNSC Twin Otter
Stop Time	14:50:47 (53447)	**Retracker**	TSRA
Distance	256.312 km	**INS Resolution**	50 Hz
Duration	00 h 57 m 58 s	**Processor Version**	0403

A140509_03

AS3OA03_ASWL1B0403201405097145101_20140509T145810_0001.DBL

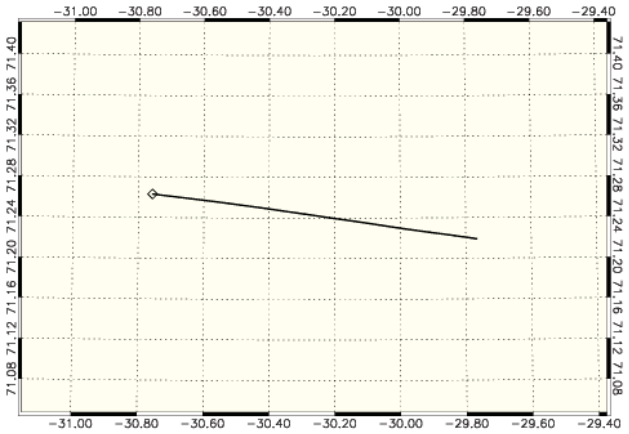


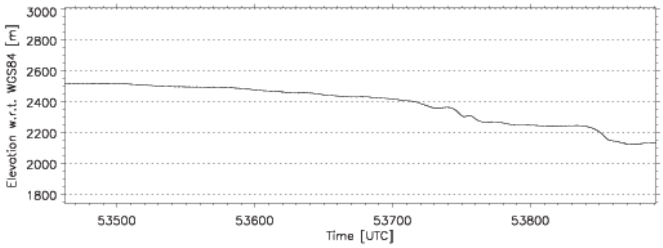


Date	2014−05−09	**Instrument Mode**	Adv. Low Altitude
Start Time	14:51:01 (53461)	**Aircraft**	DNSC Twin Otter
Stop Time	14:58:09 (53889)	**Retracker**	OCOG
Distance	35.705 km	**INS Resolution**	50 Hz
Duration	00 h 07 m 09 s	**Processor Version**	0403

A140509_03

AS3OA03_ASWL1B0403201405097145101_20140509T145810_0001.DBL





Date	2014−05−09	**Instrument Mode**	Adv. Low Altitude
Start Time	14:51:02 (53462)	**Aircraft**	DNSC Twin Otter
Stop Time	14:58:10 (53890)	**Retracker**	TSRA
Distance	35.704 km	**INS Resolution**	50 Hz
Duration	00 h 07 m 09 s	**Processor Version**	0403

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